United States Department of Energy

Nuclear Criticality Safety Program

Five-Year Execution Plan for the Mission and Vision

FY2016 through FY2020

National Nuclear Security Administration

October 2015

Department of Energy Nuclear Criticality Safety Program Five-Year Execution Plan for Fiscal Years 2016 through 2020, dated October 2015.

Approved:

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ACRONYMS AND DEFINITIONS

ACE	"A Compact ENDF" file
ADVANCE	Automated Data Verification and Assurance for Nuclear Calculations Enhancement (ADVANCE)
AM	Analytical Methods
AMPX	Nuclear cross-section processing code
ANL	Argonne National Laboratory
ARH	Atlantic Richfield Hanford
AWE	Atomic Weapons Establishment
BNL	Brookhaven National Laboratory
CAAS	Criticality Accident Alarm System
CALIBAN	Fast burst metal assembly in Valduc, France
CEA	Commissariat à l'Énergie Atomique
CIELO[1]	Collaborative International Evaluated Library Organization
COG[2]	Lawrence Livermore National Laboratory Monte Carlo Computer Code
COMET	General Purpose Platform Lift Machine at NCERC
CritView	A plotting and interpolation software program designed to display criticality data from the ARH-600 Criticality Handbook
CRP	Coordinated Research Projects
CSCT	Criticality Safety Coordinating Team
CSEWG	Cross Section Evaluation Working Group
CSSG	Criticality Safety Support Group
DAF	Device Assembly Facility
DOE	Department of Energy
ENDF	Evaluated Nuclear Data File
EOC	Explanation of Change (for out-year peaks and dips in budget plots)
FLATTOP	Highly-Reflected Spherical Benchmark Assembly
FFTF	Fast Flux Test Facility
FUDGE	Lawrence Livermore National Laboratory nuclear data management infrastructure
FY	Fiscal Year
GELINA	Linear Accelerator in Geel, Belgium
GForge	Web-based collaborative development environment
GODIVA	Unreflected Fast-Burst Assembly
IAEA	International Atomic Energy Agency

ICSBEP	International Criticality Safety Benchmark Evaluation Project
IE	Integral Experiments
IER	Integral Experiment Request
IP&D	Information Preservation and Dissemination
IRMM	Institute for Reference Materials and Measurements
IRSN	Institut De Radioprotection et De Sûreté Nucléaire
KENO^3	Monte Carlo Criticality Computer Code
KRUSTY	Kilopower Reactor Using Stirling TechnologY
LA	Los Alamos (report)
LANL	Los Alamos National Laboratory
LINAC	Linear Accelerator
LLNL	Lawrence Livermore National Laboratory
MCNP	Monte Carlo N Particle (N currently equals 3) Computer Code
NA00-10	Office of Environment, Safety and Health
NCERC	National Criticality Experiments Research Center
NCS	Nuclear Criticality Safety
NCSET	Nuclear Criticality Safety Engineer Training
NCSP	Nuclear Criticality Safety Program
NCSU	North Carolina State University
ND	Nuclear Data
NDA	non-destructive assay
NDAG	Nuclear Data Advisory Group
NJOY	Nuclear cross-section processing code
NNDC	National Nuclear Data Center
NNSA	National Nuclear Security Administration
NNSS	Nevada Nuclear Security Site
NSTec	National Security Technologies
OECD/NEA	Organization for Economic Cooperation and Development/Nuclear Energy Agency
ORNL	Oak Ridge National Laboratory
POC	Point of Contact
PREPRO	Nuclear cross-section processing code
RPI	Renssalaer Polytechnic Institute
RSICC	Radiation Safety Information Computational Center

SAMMY[4]	R-matrix nuclear data evaluation computer code
SCALE[5]	A modular modeling and simulation system for nuclear safety analysis and design
SNL	Sandia National Laboratories
SQA	Software Quality Assurance
SRS	Savannah River Site
S/U	Sensitivity/Uncertainty
TACS	Training Assembly for Criticality Safety
T&E	Training and Education
TID	Technical Information Document (Los Alamos National Laboratory report)
TRG	Technical Review Group
TSUNAMI	Tool for Sensitivity and Uncertainty Analysis Methodology Implementation
US	United States of America
UT	University of Tennessee
V&V	Verification and Validation
WPEC	Working Party on International Nuclear Data Evaluation Corporation
WPNCS	Working Party on Nuclear Criticality Safety
Y-12	Y-12 National Security Complex

[1]CIELO is a supercomputing platform that supports Los Alamos, Sandia, and Lawrence Livermore. This petascale (more than one quadrillion floating point operations per second) supercomputer helps NNSA ensure the safety, security, and effectiveness of the nuclear stockpile while maintaining the moratorium on testing.

[2]COG was originally developed to solve deep penetration problems in support of underground nuclear testing. Variance reduction techniques are very important to these problems and hence the name COG was chosen as in "to cog the dice" or cheat by weighting.

[3]KENO is a family of Monte Carlo criticality codes whose name came from an observation of the KENO game in which small spheres, under air levitation, arbitrarily move about in a fixed geometry.

[4]SAMMY is a nuclear model code, which applies R-Matrix theory to measured data and produces resolved and un-resolved resonance parameters in Reich-Moore and other formalisms.

[5]SCALE is a system of well-established codes and data for performing nuclear safety (criticality, shielding, reactor physics and fuel irradiation) analyses.

United States Department of Energy
Nuclear Criticality Safety Program
Five-Year Execution Plan

1.0 Nuclear Criticality Safety Program Mission and Vision

The Nuclear Criticality Safety Program (NCSP) Mission and Vision, as stated in *The Mission and Vision of the United States Department of Energy Nuclear Criticality Safety Program for the Fiscal Years 2014-2023* (http://ncsp.llnl.gov/NCSP-MV-COMPRESSED.pdf), are:

> The NCSP mission is to provide **sustainable expert** leadership, direction, and the technical infrastructure necessary to develop, maintain, and disseminate essential technical tools, training, and data required to support **safe, efficient** fissionable material **operations** within the United States (U.S.) Department of Energy (DOE).
>
> The NCSP will be a **continually improving, adaptable,** and **transparent** program that **communicates** and **collaborates** globally to incorporate technology, practices, and programs to be **responsive** to the essential technical needs of those responsible for developing, implementing, and maintaining nuclear criticality safety.

The NCSP is funded by the National Nuclear Security Administration (NNSA). Dr. Jerry McKamy (NA511) is the NCSP Manager. He is supported by the Criticality Safety Support Group (CSSG) and the Nuclear Data Advisory Group (NDAG), regarding technical matters, and by the Criticality Safety Coordinating Team (CSCT), consisting of Federal Criticality Safety Practitioners at the sites regarding DOE field criticality safety issues. Charters for the CSCT, CSSG, and the NDAG can be found on the NCSP website at: (http://ncsp.llnl.gov/). The NCSP Planning Calendar can also be found on the NCSP website at: (http://ncsp.llnl.gov/).

The NCSP Mission and Vision is achieved by identifying and accomplishing a set of five-year programmatic goals in five broad technical program elements that support identified ten-year goals. The NCSP Five-Year Plan defines tasks that are designed to accomplish specific goals identified in the NCSP Mission and Vision. The current Five-Year Plan has been developed to accomplish these Mission and Vision goals with the advice and assistance of **experts** appointed by the NCSP manager or working under charters approved by the NCSP manager. The five technical program elements are:

- Analytical Methods (AM)
- Information Preservation and Dissemination (IP&D)
- Integral Experiments (IE)
- Nuclear Data (ND)
- Training and Education (T&E)

The NCSP Mission and Vision provides specific goals for each program element. Each task in the current Five-Year Plan aligns with a specific NCSP Mission and Vision goal. The number of goals addressed by the current Five-Year Plan is provided in Figure 1.1. As shown in Figure 1.1, the FY16 work tasks will help address a number of NCSP Mission and Vision Goals, and additional goals will be addressed in FY17-FY20. Overall, the NCSP is on track to accomplish a significant number of Mission and Vision goals during the next five years. The subsequent discussion provides a summary of the projected task accomplishments and technical gaps for each program element.

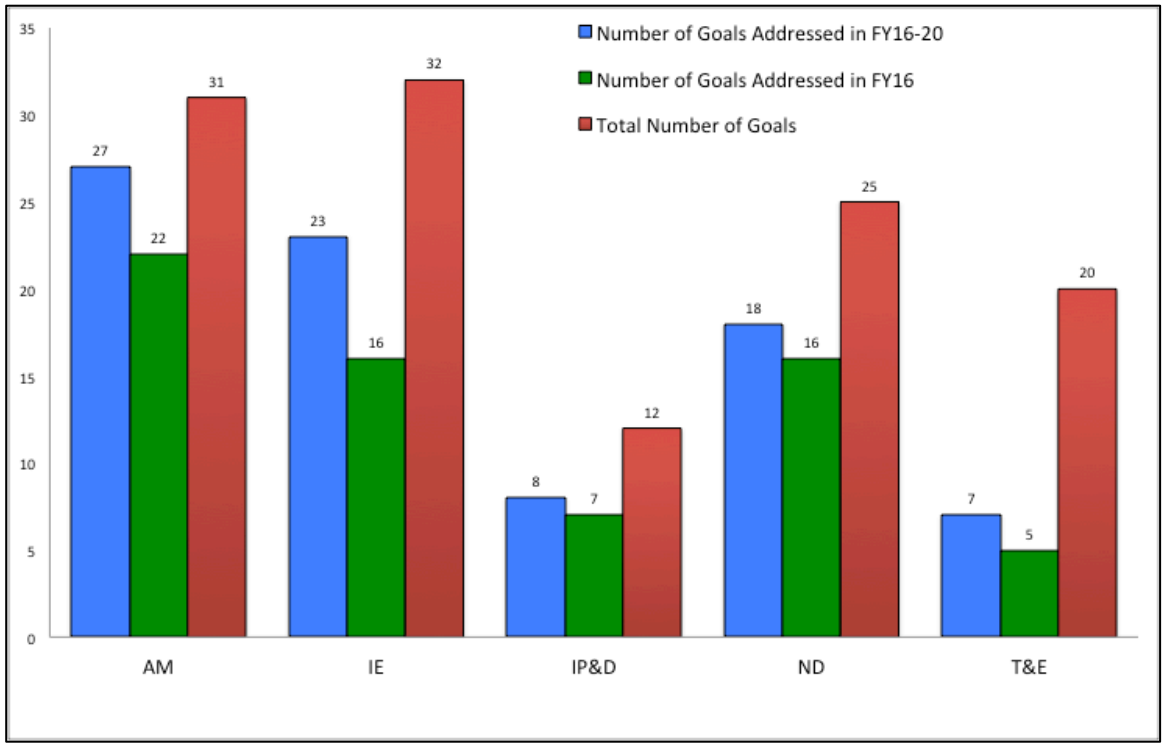


Figure 1.1 Number of NCSP Mission and Vision Program Element Goals Addressed by the NCSP Five-Year Plan

The **Analytical Methods** program element provides for the development and maintenance of state-of-the-art analytical capabilities for the processing of nuclear data from the Evaluated Nuclear Data File (ENDF) and the radiation transport analysis capabilities needed to perform nuclear criticality safety analyses. The Five-Year Plan tasks specifically support 27 of 31 AM goals required to develop and sustain state-of-the-art cross-section processing and radiation transport modeling capabilities and expertise needed for criticality safety analyses. Furthermore, FY16 work tasks will address 22 of the 31 AM goals. Examples of goals not addressed in FY16 but are addressed in the out years include: development and deployment of methods to provide correlation data for integral benchmark experiments; development and deployment of time-dependent radiation transport accident analysis capabilities. With regard to the overall AM technical gap over the next 5 years, some AM goals are not addressed based on current budget targets. Examples of goals not addressed include: the development and deployment of time-dependent multi-physics analysis capabilities to support excursion analyses; development and maintenance of time-dependent geometry modeling capabilities; coupling of modern NCS radiation transport software with CAD/CAE packages. Task

proposals have been submitted for these goals, and these proposals will be considered pending increased NCSP AM budget targets.

The **Information Preservation & Dissemination** program element preserves primary documentation supporting criticality safety [e.g., benchmark critical experiments from the International Criticality Safety Benchmark Evaluation Project (ICSBEP)] and makes this information available for the benefit of the technical community including international partners (e.g., AWE, CEA and OECD) through the NCSP website (http://ncsp.llnl.gov). The Five-Year Plan tasks specifically support 8 of 12 IP&D goals for preserving and disseminating technical, programmatic, and operational information important for nuclear criticality safety. FY16 work tasks will address 7 of 12 IP&D goals. The goal to provide a long-term hardcopy archive of critical experiment logbooks will not be addressed in FY16. Overall, there are some IP&D goals that cannot be addressed based on current budget targets. Examples of goals not addressed include: maintaining and publishing (as an electronic newsletter) a U.S./international database of near misses, operational issues and lessons learned (historical/future); implementing a process to rapidly disseminate information (e.g., operational upsets, emergency response) to criticality safety professionals ("Crit spam").

The **Integral Experiments** program element maintains a fundamental capability for the DOE NCSP to be able to perform critical, subcritical, and fundamental physics measurements, to address specific-site needs on a prioritized basis, and this program element also supports maintaining a fundamental nuclear materials handling capability, which enables hands-on NCS training programs and various other programs for the DOE NCSP and other Government Agencies. The Five-Year Plan tasks specifically support 23 of 32 IE goals to assess, design, perform, and document integral experiments. FY16 work tasks will address 16 of 32 IE goals. Examples of goals not addressed in FY16 but are addressed in the out years include: develop the infrastructure to support dynamic experiments; provide a conceptual design of a neptunium burst reactor; acquire neptunium metal. Although a smaller set of goals is addressed in FY16, a significant number of IE goals are addressed during the next five years. However, there are some IE goals that cannot be addressed within the current five-year budget targets. Examples of goals not addressed include: design and deploy a radiochemistry laboratory at NNSS; standup "hot"/"cold" machine shops at NCERC; design and deploy low scatter capabilities at NCERC. Task proposals have been submitted for these goals, and these proposals will be considered pending increased NCSP IE budget targets.

The **Nuclear Data** program element includes the measurement, evaluation, testing, and publication of neutron cross-section data for nuclides of high importance to nuclear criticality safety analyses. The Five-Year Plan tasks specifically support 18 of 25 ND goals to improve and disseminate measured and evaluated differential cross-section and covariance data needed by the AM element to support NCS analyses. FY16 work tasks will address 16 of 25 ND goals. Examples of goals not addressed in FY16 but are addressed in the out years include: identify and prioritize differential measurements beyond the next five years; identify and prioritize differential evaluations beyond the next five years; develop and deploy a new, modern ENDF/B evaluation format to replace the aging ENDF-6 format. Overall, a large number of goals are addressed within the current ND budget targets; however, technical gaps do exist, and some ND goals cannot be addressed. Examples of goals not addressed include: maintain existing resonance analysis and nuclear model software to analyze differential measured data and produce nuclear data evaluations with covariance data; develop and implement modernization plans for existing nuclear data analysis software (e.g., SAMMY, EMPIRE, GNASH, etc.); develop and utilize sensitivity/uncertainty (S/U) analysis

capabilities to prioritize NCSP nuclear data needs and quantify target accuracies needed for differential measurement and evaluation tasks. Task proposals have been submitted for these goals, and these proposals will be considered pending increased NCSP ND budget targets.

The **Training and Education** program element identifies, develops, and facilitates training needs and educational resources (including hands-on training with fissionable material systems) in areas where no suitable alternative exists. The primary purpose of the T&E element is to maintain and enhance the technical abilities and knowledge of those who impact or are impacted directly by the practice of criticality safety. The Five-Year Plan tasks specifically support 7 of 20 T&E goals during the next five years and 5 of 20 T&E goals in FY16. The tasks primarily support the development and maintenance of the classroom and "hands-on" training courses at SNL and NNSS. FY16 work tasks will not address the Mission and Vision goal to provide a gap analysis of training needs based on an assessment of available training and education resources in the national and international community. Likewise, the T&E goal to cultivate and maintain university partnerships will not be addressed in the FY16 T&E work tasks. NCSP work to partner with universities is being performed under the AM and ND program elements; however, these NCSP-university work tasks are not focused on NCS T&E activities. Overall, there are number of Mission and Vision goals that extend beyond the current scope of hands-on T&E classes. As a result, there is a technical gap within the T&E program element, and some goals cannot be accomplished within the current five-year T&E budget targets. Examples of goals not addressed include: develop and deploy a mobile (CAT III or IV material) criticality hands-on critical or near critical demonstration capability; develop and deploy tutorial on subcritical methods and benchmark interpretation for nuclear criticality safety users; develop an NCSET module on the use of criticality safety accident slide rule to support emergency response. Task proposals have been submitted for these goals and will be considered pending increased NCSP T&E budget targets.

Although some technical gaps exist in each program element, execution of the NCSP Five-Year Plan will accomplish a significant number of Mission and Vision goals during the next five years. As a result, the NCSP will be able to accomplish the overall mission to provide sustainable expert leadership, direction, and technical infrastructure needed to support safe, efficient fissionable material operations within the DOE.

2.0 Technical Program Elements

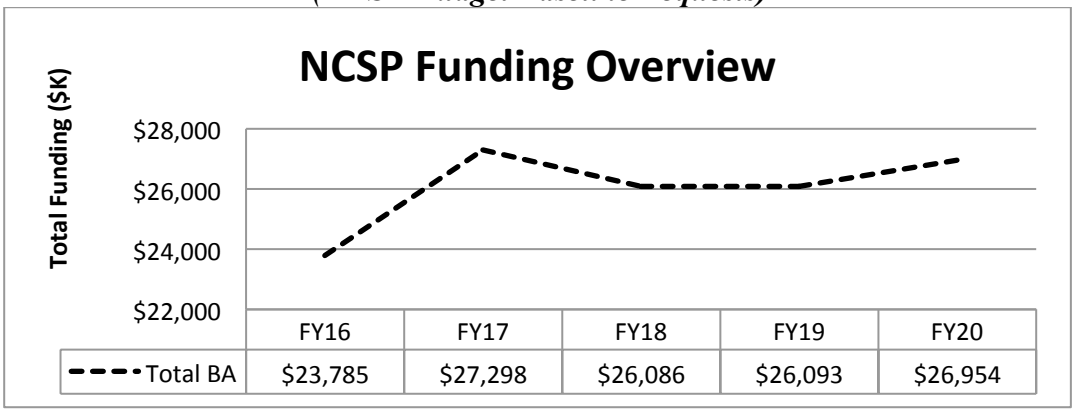
As mentioned above, the NCSP includes the following five technical program elements:

- Analytical Methods
- Information Preservation and Dissemination
- Integral Experiments
- Nuclear Data
- Training and Education

A description of how each of these elements contributes to the enhancement of criticality safety is contained in the NCSP Mission and Vision document. This Five-Year Execution Plan contains the road map for each of the five technical program elements, including a budget, tasks, and milestones for completing the work and achieving the NCSP Vision. All tasks are approved based on their contribution to the achievement of the five- and ten-year goals in the Mission and Vision document. Funding tables are provided for each program element section. The status of all milestones will be reported to the NCSP Manager in quarterly reports that are due no later than three weeks from the last day of the month following the end of the quarter.

Funding for NCSP activities are shown in Tables 2.1, 2.2, and 2.3 (rounded to the nearest $K).

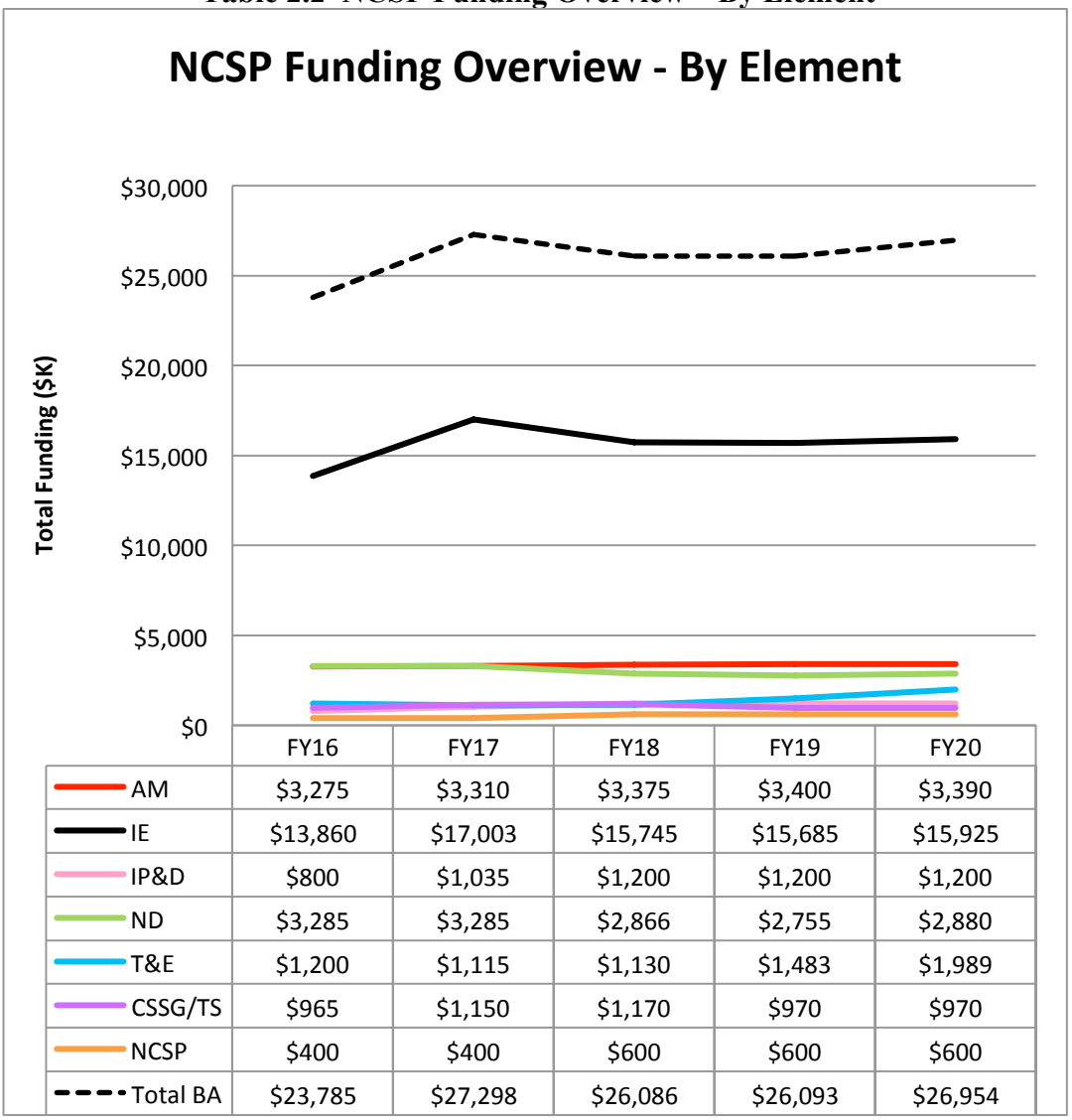
Table 2.1 NCSP Funding Overview
(NNSA Budget Baseline Requests)



	FY16	FY17	FY18	FY19	FY20
Total BA	$23,785	$27,298	$26,086	$26,093	$26,954

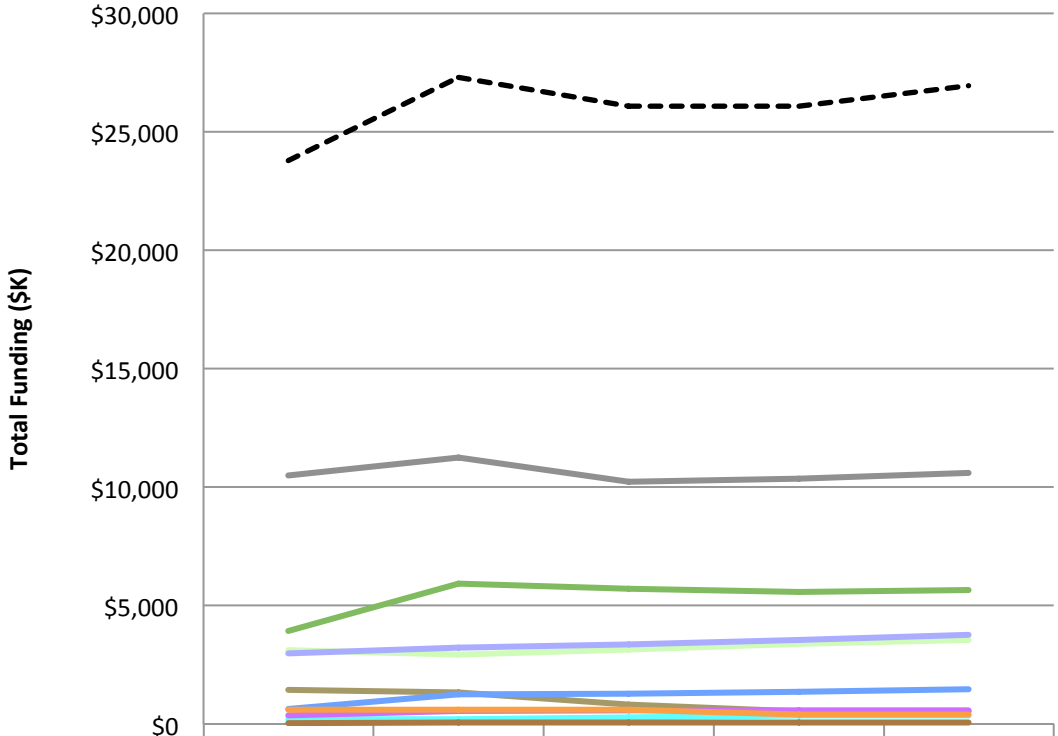
Total BA: Authorized Baseline Budget spend from allocated funding

Table 2.2 NCSP Funding Overview – By Element



	FY16	FY17	FY18	FY19	FY20
AM	$3,275	$3,310	$3,375	$3,400	$3,390
IE	$13,860	$17,003	$15,745	$15,685	$15,925
IP&D	$800	$1,035	$1,200	$1,200	$1,200
ND	$3,285	$3,285	$2,866	$2,755	$2,880
T&E	$1,200	$1,115	$1,130	$1,483	$1,989
CSSG/TS	$965	$1,150	$1,170	$970	$970
NCSP	$400	$400	$600	$600	$600
Total BA	$23,785	$27,298	$26,086	$26,093	$26,954

Table 2.3 NCSP Funding Overview – By Laboratory
(Actual Funding)



	FY16	FY17	FY18	FY19	FY20
BNL	$200	$210	$275	$350	$360
LANL	$10,487	$11,242	$10,227	$10,352	$10,612
LLNL	$3,120	$2,930	$3,156	$3,373	$3,535
NNSS	$3,918	$5,918	$5,718	$5,568	$5,668
ORNL	$2,980	$3,218	$3,370	$3,540	$3,769
RPI	$1,450	$1,330	$830	$530	$530
SNL	$635	$1,240	$1,290	$1,360	$1,460
SRS	$30	$60	$50	$50	$50
CSSG	$365	$550	$570	$570	$570
NCSP	$600	$600	$600	$400	$400
Total BA	$23,785	$27,298	$26,086	$26,093	$26,954

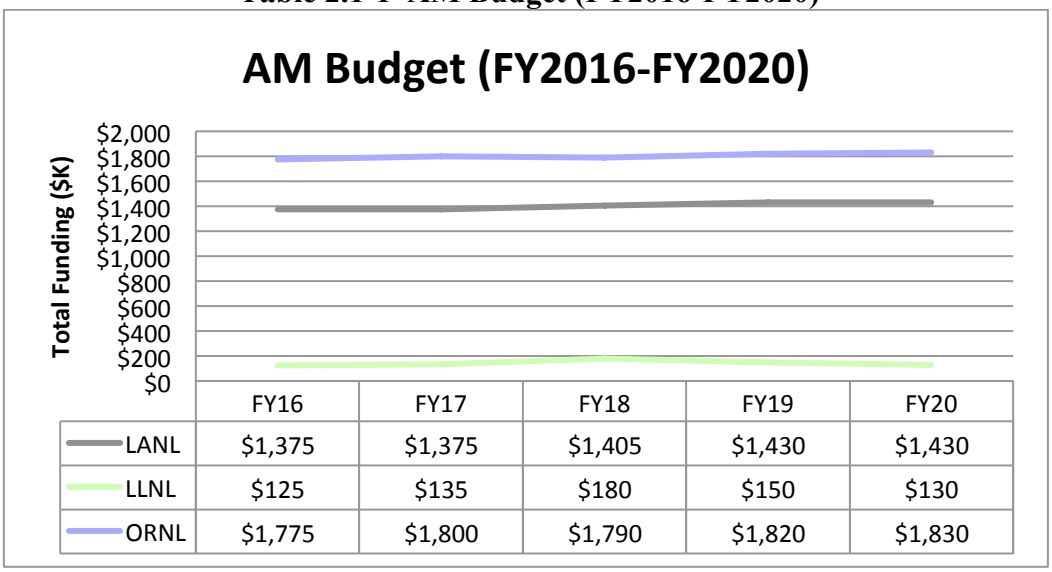
Finally, the goal of the NCSP is to provide "transparent responsiveness" for the DOE and Stakeholders. Therefore, this Plan and all accomplishments achieved under the auspices of the NCSP are posted in a timely manner on the NCSP website at: http://ncsp.llnl.gov/.

2.1 Analytical Methods (AM)

2.1.1 Program Element Description

The Analytical Methods program element provides development and maintenance of state-of-the-art analytical capabilities for the processing of nuclear data from the Evaluated Nuclear Data File (ENDF) and the radiation transport analysis needed to support Nuclear Criticality Safety (NCS) evaluations for subcriticality and shielding. An essential aspect of the AM capabilities is the human expertise required to develop the analytical software, provide software configuration control, and train and assist the user community.

Table 2.1-1 AM Budget (FY2016-FY2020)



	FY16	FY17	FY18	FY19	FY20
LANL	$1,375	$1,375	$1,405	$1,430	$1,430
LLNL	$125	$135	$180	$150	$130
ORNL	$1,775	$1,800	$1,790	$1,820	$1,830

2.1.2 Approved Tasks

2.1.2.1 Los Alamos National Laboratory (LANL)

LANL AM1 ($1100K) [IRSN Area of Collaboration (See Appendix E**)]**

This is a continuing task for the maintenance of the basic capabilities for performing Nuclear Criticality Safety calculations with the Monte Carlo N Particle (MCNP) computer code, including general code maintenance, user support, improved nuclear data libraries, Verification and Validation (V&V), documentation, user training, and implementation of limited new capabilities; focus on modernizing MCNP for next-generation computing hardware; continue to develop MCNP for continuous-energy sensitivity / uncertainty analysis, and contribute to the Organization for Economic Cooperation and Development/Nuclear Energy Agency (OECD/NEA) Working Party on Criticality Safety. For all tasks, LANL reports will be issued and posted on the MCNP website.

LANL AM2 ($275K) [IRSN Area of Collaboration (See Appendix E**)]**

This is a continuing task to support development and maintenance of the NJOY nuclear data processing code system, implement capabilities as needed to process new general purpose nuclear data files in the continuously evolving ENDF-6 format, provide support to NJOY users, modernize NJOY to adapt to modern code practices, new data formats, and next-generation computing hardware, and contribute to the NDAG, the Cross Section Evaluation Working Group (CSEWG), CIELO, the Working Party on International Nuclear Data Evaluation Corporation (WPEC) and the International Atomic Energy Agency (IAEA) Coordinated Research Projects (CRP) as approved by the NCSP Manager. All NJOY updates will be distributed to users through a LANL maintained website.

Table 2.1-2 LANL AM Budget Trend (FY2016-FY2020)

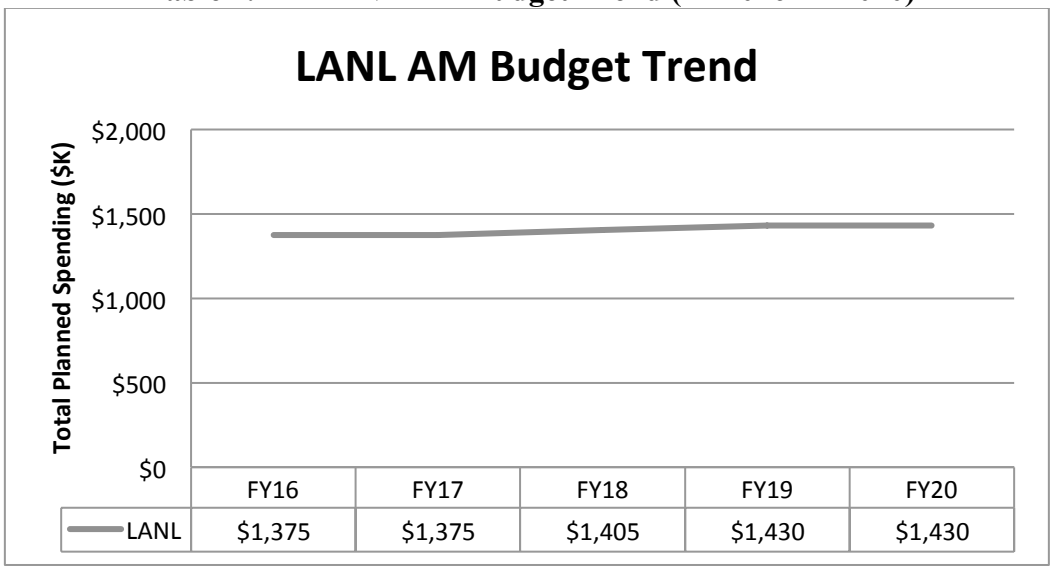
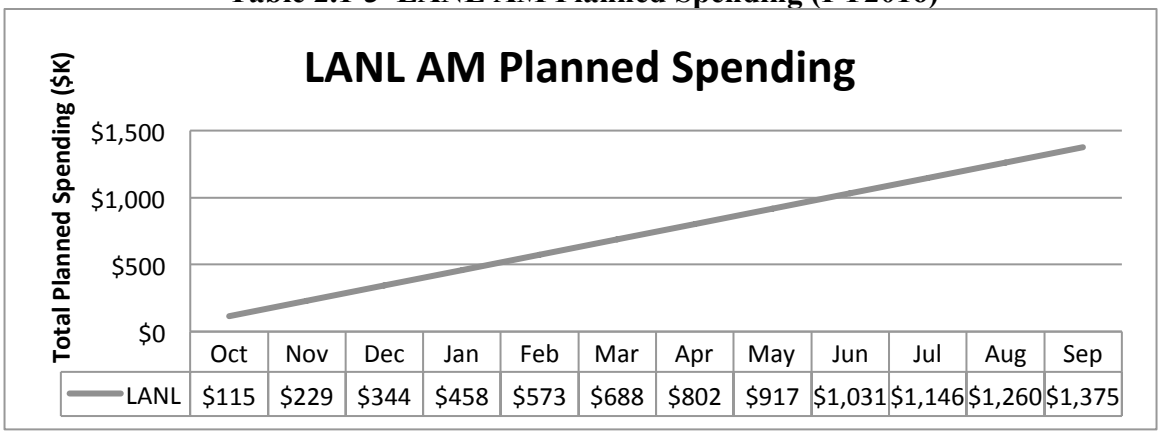


Table 2.1-3 LANL AM Planned Spending (FY2016)



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LANL	$115	$229	$344	$458	$573	$688	$802	$917	$1,031	$1,146	$1,260	$1,375

LANL AM Milestones:

Occurs all 4 Quarters

- Provide status reports on LANL participation in US and International Analytical Methods collaborations and provide brief trip summary report to NCSP Manager on items of NCSP interest (AM1, AM2: All Qtrs).
- Support users of MCNP6 and NJOY (AM1, AM2: All Qtrs).

Quarter 1

- Provide training courses on the theory and practice of Monte Carlo criticality calculations with MCNP (AM1: Q1).
- Complete the necessary NJOY code upgrade to allow creation of ace covariance library files (AM2: Q1).

Quarter 2

- Issue an MCNP V&V report (AM1: Q2).
- Release prototype MCNP covariance library (AM1: Q2).

Quarter 3

- Production release of Whisper-1.1 for sensitivity-uncertainty-based validation, available to DOE NCSP community (AM1: Q3).

Quarter 4

- Release next production version of MCNP6, including Whisper and cross-section libraries on schedules consistent with development plans (AM1: Q4).
- Provide status report on MCNP 2020 code modernization effort (AM1: Q4).
- Create an ACE reader/writer for NJOY21 Q4 (AM2: Q4).

Explanation of Change (EOC) – for out-year peaks and dips in budget plots:

Modest increases in out-years for MCNP modernization. Note additional over-target budget requested in out years to further address MCNP support and modernization needs (see Appendix D).

2.1.2.2 Lawrence Livermore National Laboratory (LLNL)

LLNL AM1 ($100K) [IRSN Area of Collaboration (See Appendix E**)]**
This is an ongoing approved task to provide maintenance, user support and minor upgrades to existing LLNL analytical methods including nuclear data processing, geometry modeling and Monte-Carlo and multiphysics methods. This task also supports on-going LLNL assistance to Brookhaven National Laboratory (BNL), the IAEA and North Carolina State University (NCSU) in developing and maintaining FUDGE, PREPRO and other nuclear data processing code systems as needed to process distribute and test new general-purpose nuclear data files in evolving ENDF-6 format. The task also supports participation in NCSP activities including the Analytical Methods Working Group, CSEWG and NDAG.

LLNL AM2 ($0K) [AWE and IRSN Area of Collaboration (See Appendix E and F**)]**
This is an ongoing approved task to support building upon existing LLNL state-of-the-art 3-D analytical multi-physics methods to develop and validate these methods for simulation of criticality excursions. Although $0K NCSP funding is allocated for this task, the task is authorized and work will be performed through international collaboration efforts. The task will support work to simulate the response of GODIVA or CALIBAN to a fast reactivity insertion of various magnitudes and to simulate the GODIVA accidents including quantification of mechanical damage to support structures and surface oxidation and to add delayed neutron and photon emission physics.

LLNL AM3 ($25K) [AWE and IRSN Area of Collaboration (See Appendix E and F**)]**
This is an ongoing approved task to collaborate with IRSN and ORNL to generate a criticality slide rule for plutonium systems.

Table 2.1-4 LLNL AM Budget Trend (FY2016-FY2020)

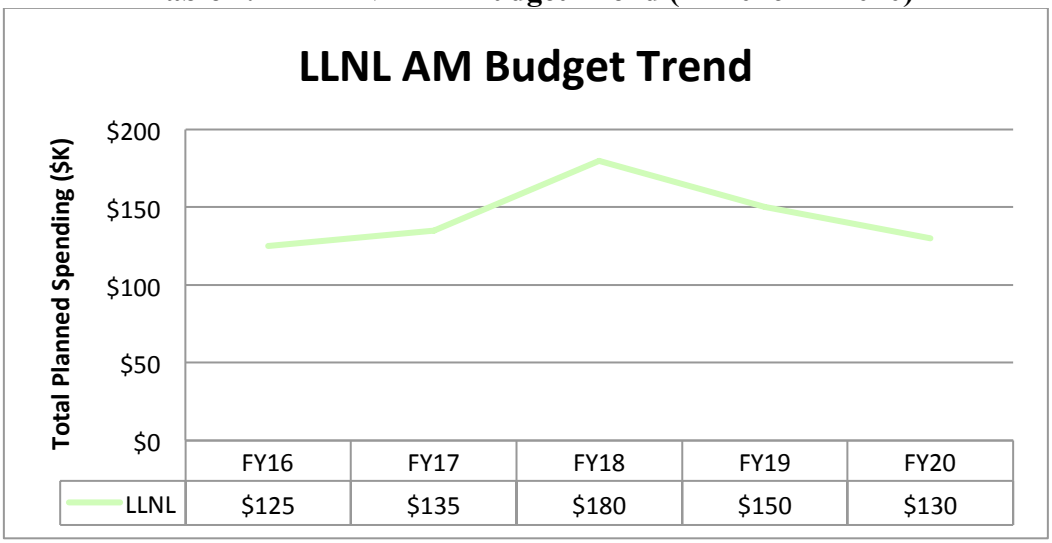
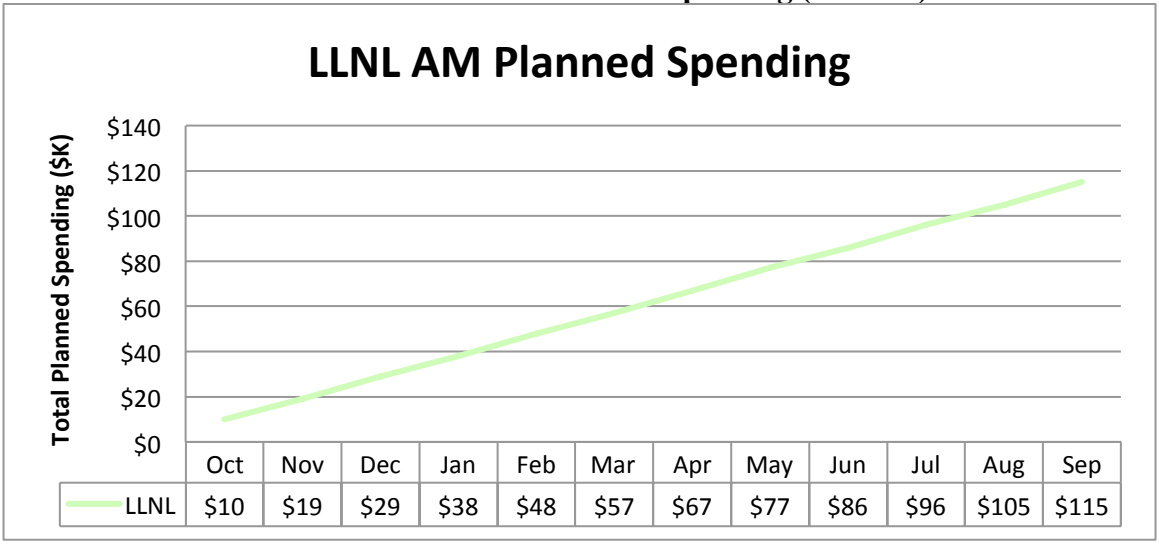


Table 2.1-5 LLNL AM Planned Spending (FY2016)*



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LLNL	$10	$19	$29	$38	$48	$57	$67	$77	$86	$96	$105	$115

* LLNL Planned Spending reduced by approximately 8% to account for required laboratory hold-back during FY continuing resolution (CR) funding uncertainty.

LLNL AM Milestones:

Occurs all 4 Quarters

- Provide status on LLNL AM activities in NCSP Quarterly Progress Reports (AM1: All Qtrs).

Quarter 4

- Complete annual IRSN-LLNL-ORNL status report on the SlideRule development and provide report to NCSP Manager (AM3: Q4).

EOC – for out-year peaks and dips in budget plots:

An increase in FY17 due to increased funding of the collaboration with ORNL and IRSN on the Plutonium Slide Rule application task and for the multi-physics methods task, decrease in out-years due to NCSP Management decision to stop support for COG due to funding constraints.

The COG code system is used almost exclusively by LLNL, unlike the widely used code systems SCALE and MCNP.

2.1.2.3 Oak Ridge National Laboratory (ORNL)

ORNL AM1 ($375K)

This is an ongoing approved task for RSICC to collect, update, package, and distribute software and associated nuclear data libraries to the criticality safety community (i.e., SCALE, MCNP, VIM, and COG and nuclear data processing (i.e., NJOY, AMPX and SAMMY)). Also, test and disseminate processed nuclear data associated with the software. The NCSP co-supports RSICC with other federal agencies, and the NCSP funding ensures the NCS codes and data are provided to support criticality safety users. RSICC deliverables and progress are reported to the NCSP through quarterly status reports.

ORNL AM2 ($1100K) [IRSN Area of Collaboration (See Appendix E**)]**

This is an ongoing approved task to provide SCALE/KENO/TSUNAMI maintenance and user support for performing Nuclear Criticality Safety (NCS) calculations with the SCALE package. Work tasks include: sustaining and continually improving SCALE NCS features through user-driven enhancements, software quality assurance (SQA) and V&V; assuring adaptability to various computing platforms and compilers; providing improved user interfaces and user documentation consistent with modern engineering software; supporting responsive communication to SCALE criticality safety users through SCALE Newsletters, email notices, and updates on the SCALE website. The task also includes support for modernizing the software infrastructure and capabilities to improve quality and reliability and to ensure long-term sustainability of the NCS capabilities.

ORNL AM3 ($275K) [IRSN Area of Collaboration (See Appendix E**)]**

This is an ongoing approved task to develop and maintain the AMPX nuclear data processing code system to provide cross-section and covariance data libraries for NCS radiation transport software such as SCALE. In addition, the task includes additional effort to implement new software enhancements needed to improve the quality and reliability of the nuclear data libraries that are produced by AMPX. The overall development and maintenance work effort will ensure the AMPX software is up-to-date and in conformance with ENDF/B formats and procedures. Moreover, the development and enhancements to the AMPX software will enable improved nuclear data processing capabilities needed to provide reliable nuclear data libraries to support radiation transport methods development and analyses.

ORNL AM6 ($25K) [AWE and IRSN Area of Collaboration (See Appendix E and F**)]**

This is a new approved task to collaborate with IRSN and LLNL to modernize the existing SlideRule accident response tool. ORNL developed the initial SlideRule, and under this task, IRSN will update the SlideRule using modern radiation transport tools (e.g., SCALE, MCNP, COG, etc.) and expand the SlideRule capabilities. Funding for this task will enable ORNL and LLNL to consult with IRSN on the SlideRule modernization effort and perform review tasks as needed to assess the performance of the updated SlideRule capability.

Table 2.1-6 ORNL AM Budget Trend (FY2016-FY2020)

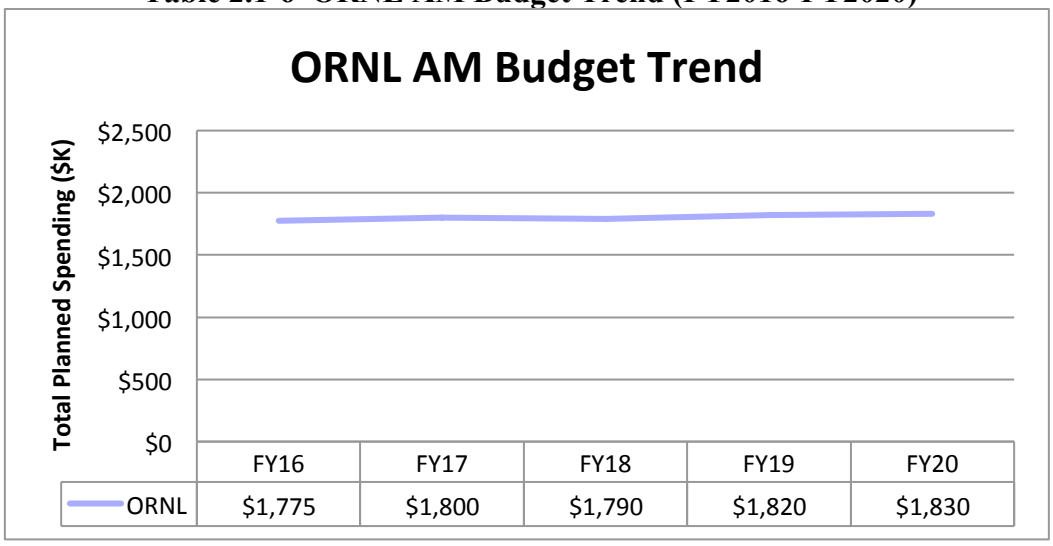
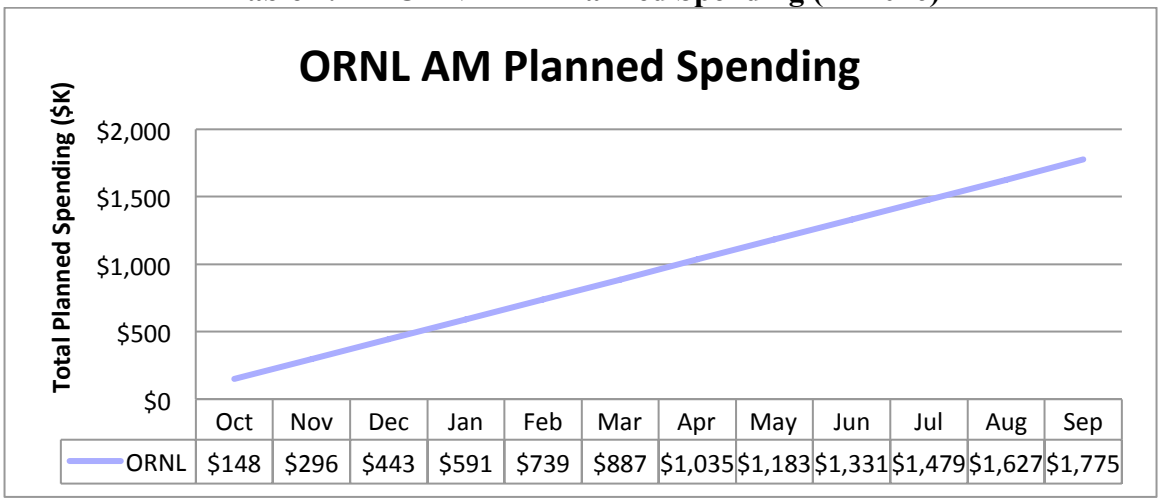


Table 2.1-7 ORNL AM Planned Spending (FY2016)



ORNL AM Milestones:

Occurs all 4 Quarters

- Continue RSICC distribution of available and newly packaged software to the NCS community requesters (at no direct cost to them) and provide distribution totals quarterly (AM1: All Qtrs).
- Provide status reports on ORNL participation in US and International Analytical Methods collaborations and provide brief trip summary report to NCSP Manager on items of NCSP interest (AM2, AM3: All Qtrs).

Quarter 2

- Issue an annual SCALE maintenance report to the NCSP Manager (AM2: Q2).
- Document AMPX modernization and technical support for SCALE CE, multigroup, and covariance libraries and report status annually to the NCSP Manager (AM3: Q2).

Quarter 4

- Publish annual SCALE newsletter to users to communicate software updates, user notices, generic technical advice, and training course announcements (AM2: Q4).
- Complete annual IRSN-LLNL-ORNL status report on the SlideRule development and provide report on deliverables and schedule to NCSP Manager (AM6: Q4).

EOC – for out-year peaks and dips in budget plots:

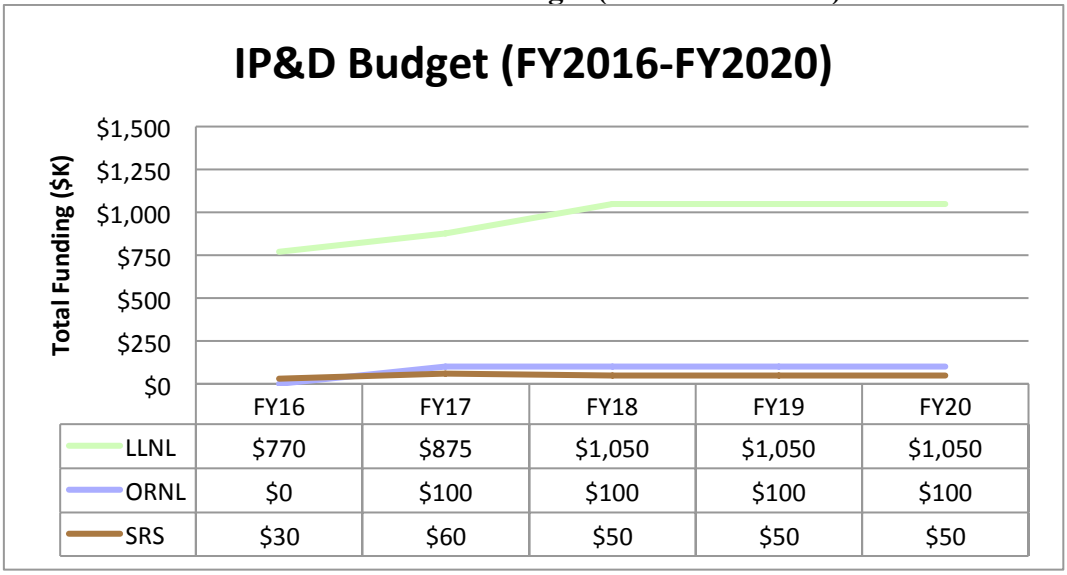
Additional increase in FY17 due to increased funding for the collaboration with ORNL and IRSN on the Handheld Slide Rule application task. Very modest increases in out-years for the development of advanced sensitivity analysis capabilities for foil activation experiment designs as defined in the NCSP Mission and Vision document.

2.2 Information Preservation and Dissemination (IP&D)

2.2.1 Program Element Description

The Information Preservation and Dissemination program element preserves primary documentation supporting criticality safety and makes this information available for the benefit of the technical community. The NCSP website (http://ncsp.llnl.gov) is the central focal point for access to criticality safety information collected under the NCSP, and the gateway to a comprehensive set of hyperlinks to other sites containing criticality safety information resources.

Table 2.2-1 IP&D Budget (FY2016-FY2020)



	FY16	FY17	FY18	FY19	FY20
LLNL	$770	$875	$1,050	$1,050	$1,050
ORNL	$0	$100	$100	$100	$100
SRS	$30	$60	$50	$50	$50

2.2.2 Approved Tasks

2.2.2.1 Lawrence Livermore National Laboratory (LLNL)

LLNL IP&D1 ($230) [AWE and IRSN Area of Collaboration (See Appendix E and F)**]**
This is an ongoing approved task that provides independent and Technical Review Group (TRG) reviews for all newly completed NCSP funded experiments. Priority historical experiments will be evaluated and reviewed (internal, independent, and TRG) as resources allow. All NCSP funded experiments will be finalized and published on the NCSP website within two quarters of receipt of an Experiment Design Team reviewed and approved draft report (CED-4a). LLNL IP&D1 will also provide leadership, coordination, and publication support for the OECD/NEA ICSBEP.

LLNL IP&D2 ($490K)
This is an ongoing approved task for operation, maintenance and modernization of both unclassified and classified NCSP websites. The NCSP websites are the central focal point for access to criticality safety information collected under the NCSP, and are the gateway to a comprehensive set of hyperlinks to other sites containing criticality safety information resources. This task also provides operations and maintenance for information technology supporting the NCERC (e.g., "Red" network).

LLNL IP&D3 ($50K)
This is a new approved task to create a searchable database of all NCSP funded work.

Table 2.2-2 LLNL IP&D Budget Trend (FY2016-FY2020)

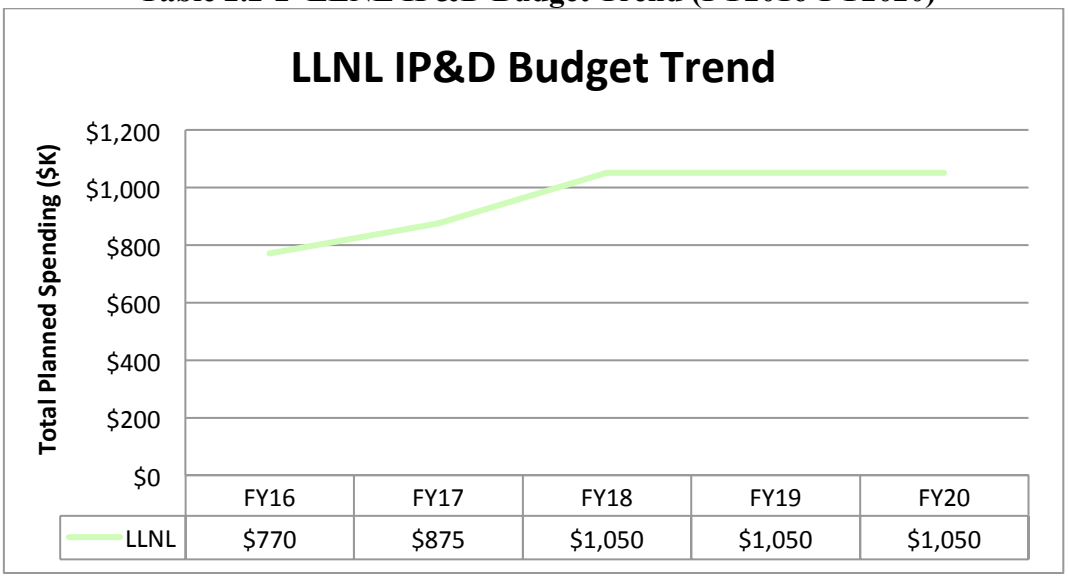
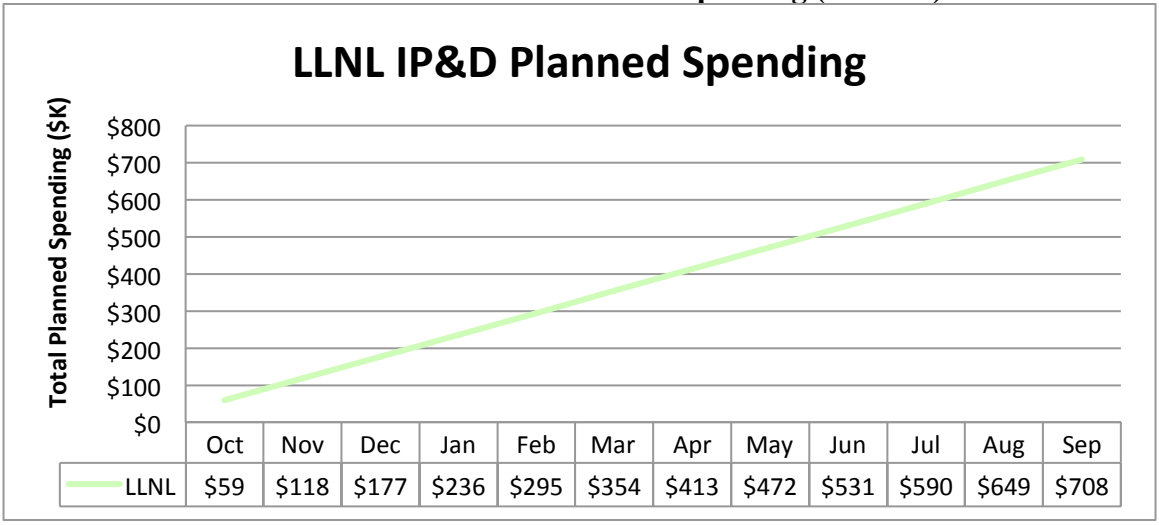


Table 2.2-3 LLNL IP&D Planned Spending (FY2016)*



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LLNL	$59	$118	$177	$236	$295	$354	$413	$472	$531	$590	$649	$708

* LLNL Planned Spending reduced by approximately 8% to account for required laboratory hold-back during FY CR funding uncertainty.

LLNL IP&D Milestones:

Occurs all 4 Quarters

- Manage all aspects of the DOE NCSP participation in the ICSBEP as required to ensure the finalizing and publishing ICSBEP evaluations per IE schedule and provide status in quarterly reports (IPD1: All Qtrs).
- Provide status reports on LLNL participation in US and International IP&D collaborations (including ICSBEP) and provide brief summary report to NCSP Manager on items of NCSP interest (IPD1: All Qtrs).
- Maintain, operate and modernize both unclassified and classified NCSP websites, databases, and "Red" network and provide user assistance as required and provide status in quarterly reports (IPD2: All Qtrs).

Quarter 4

- Create a searchable database of all NCSP funded work and provide report to NCSP Manager (AM3: Q4).

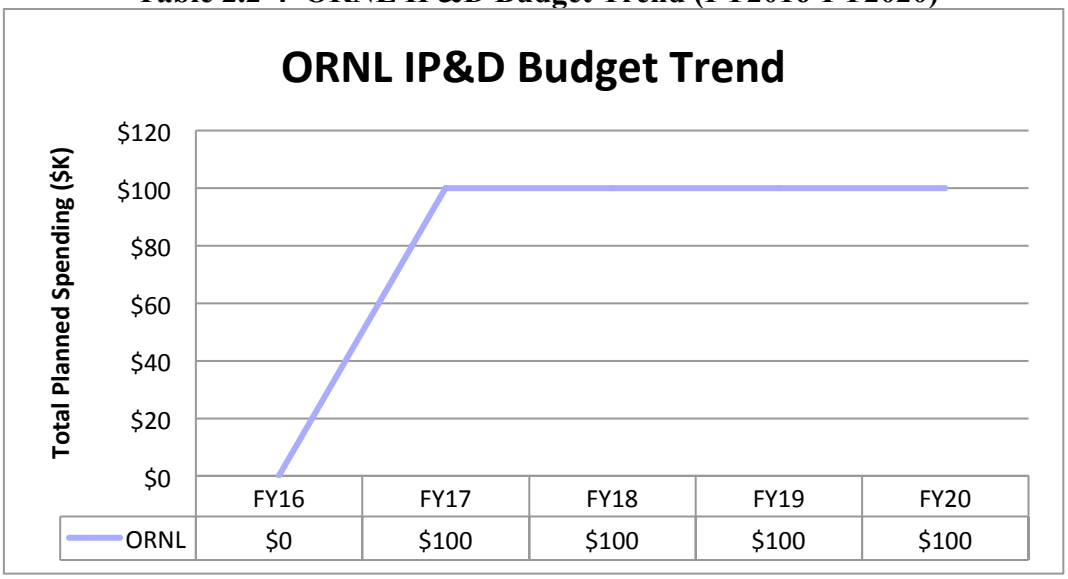
EOC – for out-year peaks and dips in budget plots:

Initial increase in FY17 to increase funding for website modernization and maintenance. In FY18 increase in funding for ICSBEP capabilities, tasks, and milestones.

2.2.2.2 Oak Ridge National Laboratory (ORNL)

ORNL IP&D4 ($0K) [IRSN Area of Collaboration (See Appendix E**]**
This is an ongoing approved task to work with IRSN as needed to support NCSP efforts to provide experimental uncertainty correlations for select ICSBEP benchmarks and provide guidance documentation and automated tools for experimental uncertainty correlation determination. Although $0K NCSP funding is allocated for this task, the task is authorized and work will be performed through international collaboration efforts.

Table 2.2-4 ORNL IP&D Budget Trend (FY2016-FY2020)



EOC – for out-year peaks and dips in budget plots:
Increase in funding in out-years for planned work to provide experimental uncertainty correlation data for select ICSBEP benchmarks.

2.2.2.3 Savannah River Site (SRS)

SRS IP&D1 ($30K)

This is new work for SRS that is a continuation of work started at Hanford to support the effort to revise the CritView code. CritView is an electronic handbook for criticality safety. It has been developed to preserve the ARH-600 data that provides plots of critical dimensions versus concentration for a variety of geometries and materials. An additional objective of the task is to provide additional data sets beyond ARH-600. As part of this task CritView will be updated to 1) better handle large databases to support improved functionality and significantly more data, and 2) upgrade the user interface to provide a more efficient and user friendly program. Also provide limited response to user queries, any error identification, and database management.

Table 2.2-5 SRS IP&D Budget Trend (FY2016-FY2020)

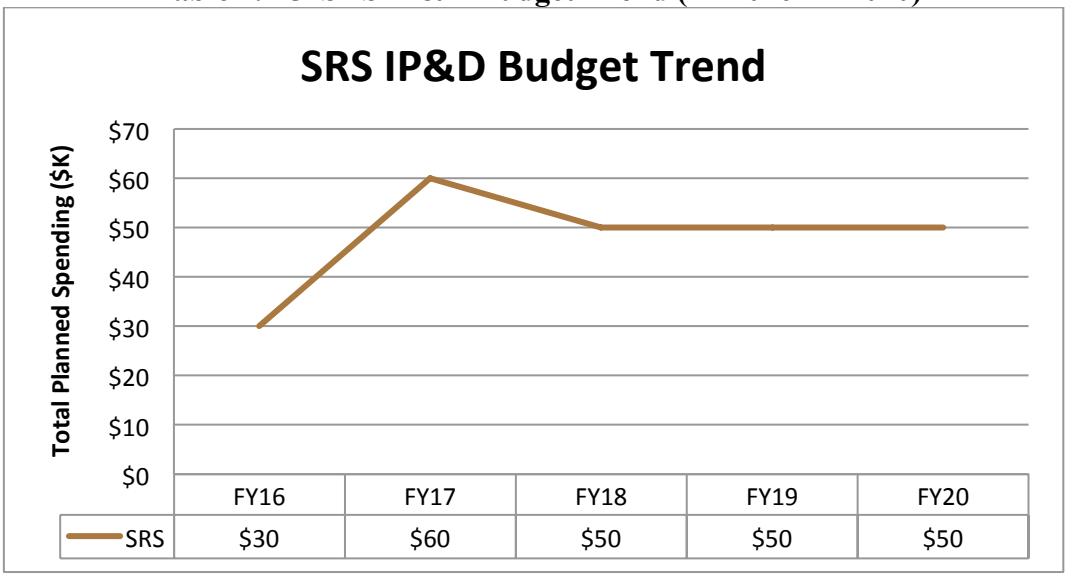
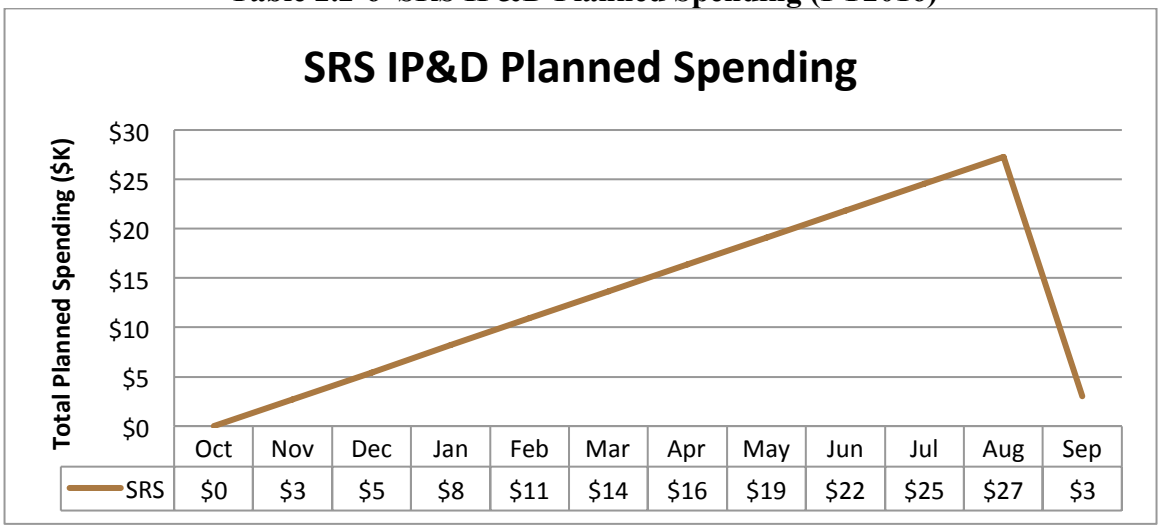


Table 2.2-6 SRS IP&D Planned Spending (FY2016)



SRS IP&D Milestones:

Quarter 4

- Provide a development plan for the major updated CritView code and associated database file to guide upgrade in out-years (IPD1: Q4).

EOC – for out-year peaks and dips in budget plots:

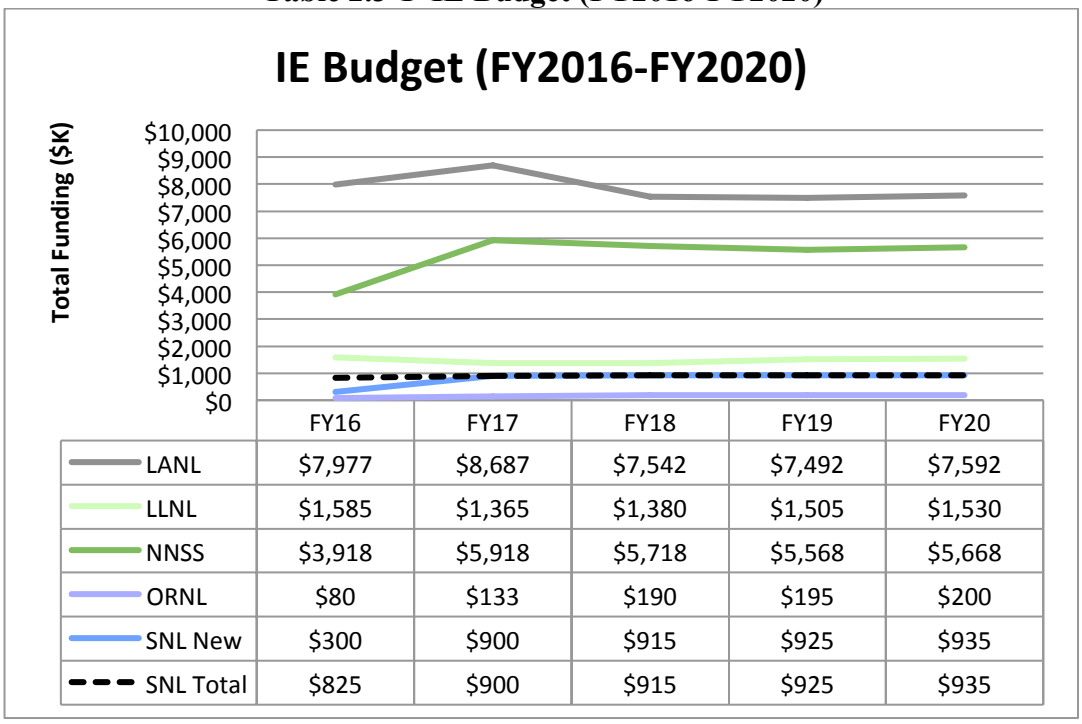
Initial increase in funding in FY17 is to support the major modification to the CritView code necessary to handle data points from additional references, such as from LA-10860 and TID-7016, handle data from multiple codes (MCNP, SCALE, etc.) with a range of k-effectives, and make the code interface more user friendly as defined in the NCSP Mission and Vision document. Out-year funding decreases to a maintenance level as upgrades will be complete.

2.3 Integral Experiments (IE)

2.3.1 Program Element Description

The Integral Experiments program element maintains a fundamental capability for the DOE NCSP to be able to perform critical, subcritical, and fundamental physics measurements, within the limits of its resources, to address criticality physics needs, emerging data improvement needs by DOE programs, and specific-site needs on a prioritized basis. This program element supports the entire cost of the LANL NCERC permanent party staff and also supports maintaining a fundamental nuclear materials handling capability, which enables hands-on NCS training programs and various other programs for the DOE NCSP and other government agencies.

Table 2.3-1 IE Budget (FY2016-FY2020)



	FY16	FY17	FY18	FY19	FY20
LANL	$7,977	$8,687	$7,542	$7,492	$7,592
LLNL	$1,585	$1,365	$1,380	$1,505	$1,530
NNSS	$3,918	$5,918	$5,718	$5,568	$5,668
ORNL	$80	$133	$190	$195	$200
SNL New	$300	$900	$915	$925	$935
SNL Total	$825	$900	$915	$925	$935

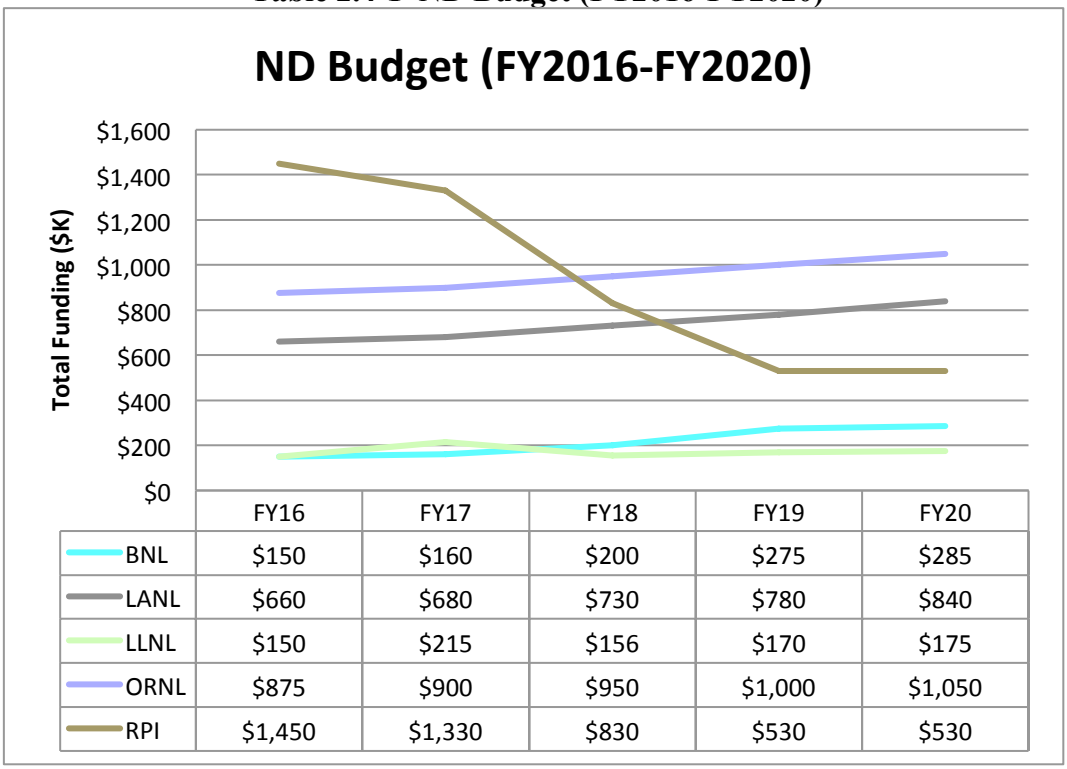
All Integral Experiment tasks and milestones are published as a standalone document. Contact the NSCP Program Manager, Dr. Jerry McKamy, if you have a 'Need-to-Know.'

2.4 Nuclear Data (ND)

2.4.1 Program Element Description

The Nuclear Data program element includes the measurement, evaluation, testing, and publication of neutron cross-section data for nuclides of high importance to NCS analyses. The NCSP continues to improve coordination of ND activities by fostering a strong collaborative effort among all of the national and international resources in this highly technical area. The objective is to solve the highest priority ND problems relevant to criticality safety in a timely manner. This program element is essential for the NCSP because it provides the nuclear cross-section data required by the AM program element. Refer to Appendix B for the FY2016 through FY2020 schedule, milestones, and deliverables associated with specific nuclear data measurement, evaluation, and publication. Milestones not contained in Appendix B are delineated below.

Table 2.4-1 ND Budget (FY2016-FY2020)



	FY16	FY17	FY18	FY19	FY20
BNL	$150	$160	$200	$275	$285
LANL	$660	$680	$730	$780	$840
LLNL	$150	$215	$156	$170	$175
ORNL	$875	$900	$950	$1,000	$1,050
RPI	$1,450	$1,330	$830	$530	$530

2.4.2 Approved Tasks

2.4.2.1 Brookhaven National Laboratory (BNL)

BNL ND1 ($150K)

This is an ongoing approved task to provide technical support to the NCSP to ensure that NCSP cross-section evaluations are checked, processed, visualized, reviewed, archived, and made available through the National Nuclear Data Center (NNDC) GForge system as candidate evaluations for the future versions of the ENDF/B library. Maintain Atlas of Neutron Resonances as a unique resource of thermal and resonance data and their uncertainties.

Table 2.4-2 BNL ND Budget Trend (FY2016-FY2020)

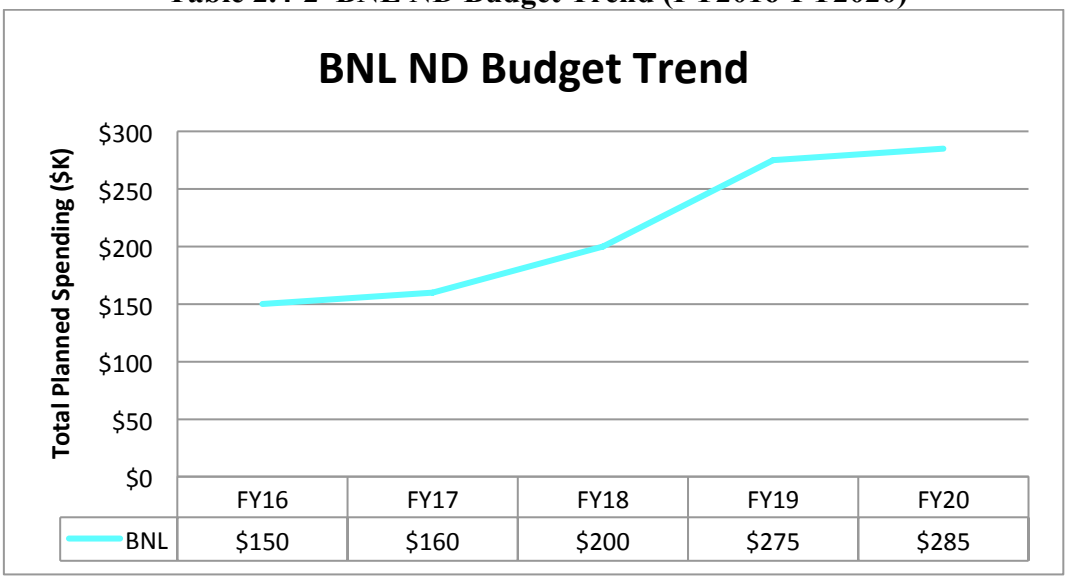
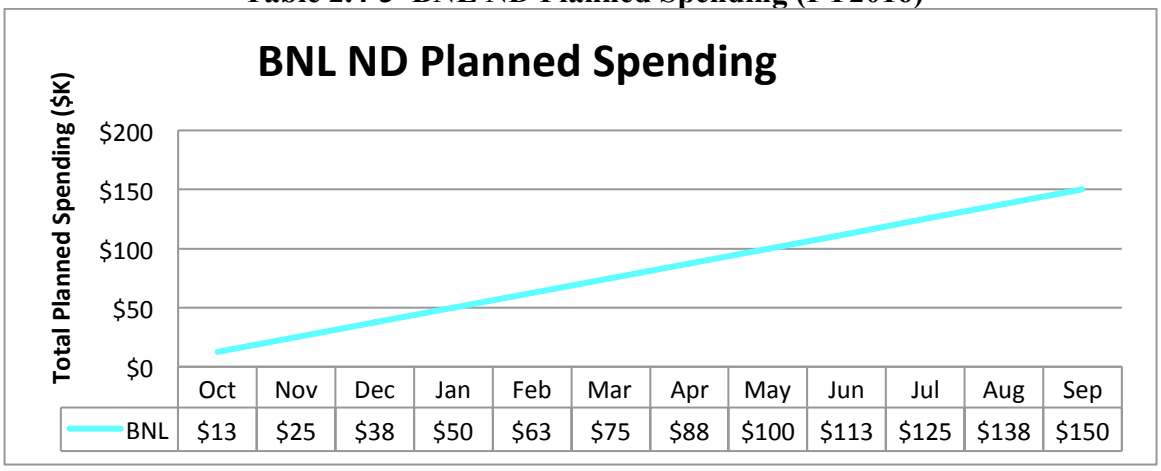


Table 2.4-3 BNL ND Planned Spending (FY2016)



BNL ND Milestones:

Occurs all 4 Quarters

- Maintain and upgrade ADVANCE code system by performing data verification of new NCSP evaluations and performing quality assurance on the data as required and provide status reports on all nuclear data support activities to the NCSP Manager (ND1: All Qtrs).

Quarter 3

- If mandated by CSEWG, release new ENDF library (ND1: Q3).

EOC – for out-year peaks and dips in budget plots:

Steady funding in FY17 due to a continuation of milestones for ADVANCE. Increase in funding in out-years for additional work on ADVANCE as defined in the NCSP Mission and Vision document.

2.4.2.2 Los Alamos National Laboratory (LANL)

LANL ND1 ($630K) [IRSN Area of Collaboration (See Appendix E**]**

This is an ongoing approved task to provide differential data evaluation and covariance development in the energy region above the resonance range for heavy elements (often in partnership with resonance-range work from ORNL), and over the entire ENDF energy range for light elements. Particular focus will be on neutron fission. Perform data testing analysis with new evaluated sets. Contribute to NDAG, CSEWG, CIELO, WPEC, and IAEA CRP.

LANL ND2 ($30K)

This is a new approved task for LANL to provide support for the NDAG Chairmanship, participation in relevant Working Groups, and coordination of the NCSP ND element work program with current and future DOE needs.

Table 2.4-4 LANL ND Budget Trend (FY2016-FY2020)

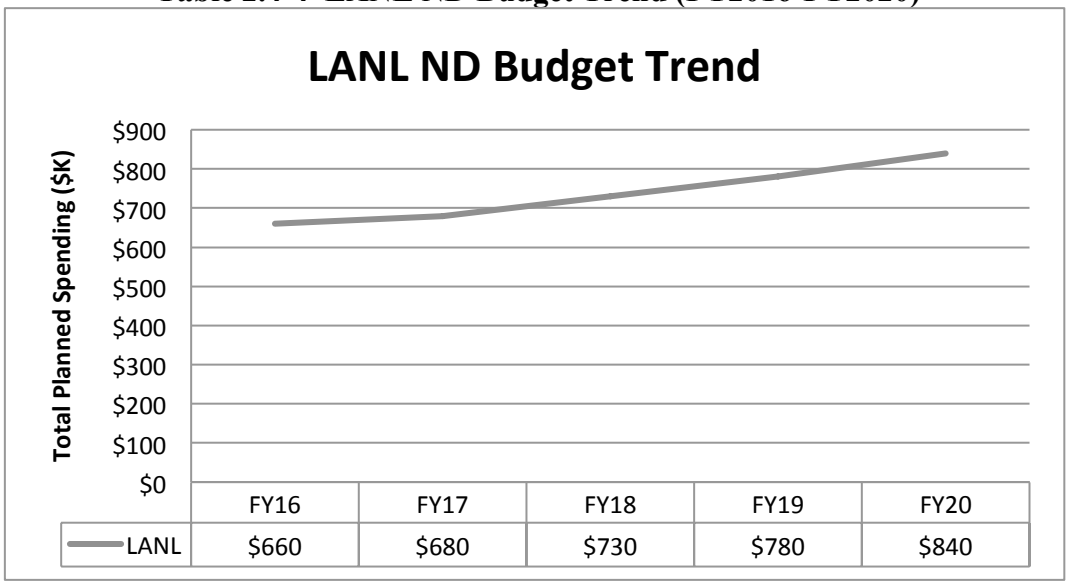
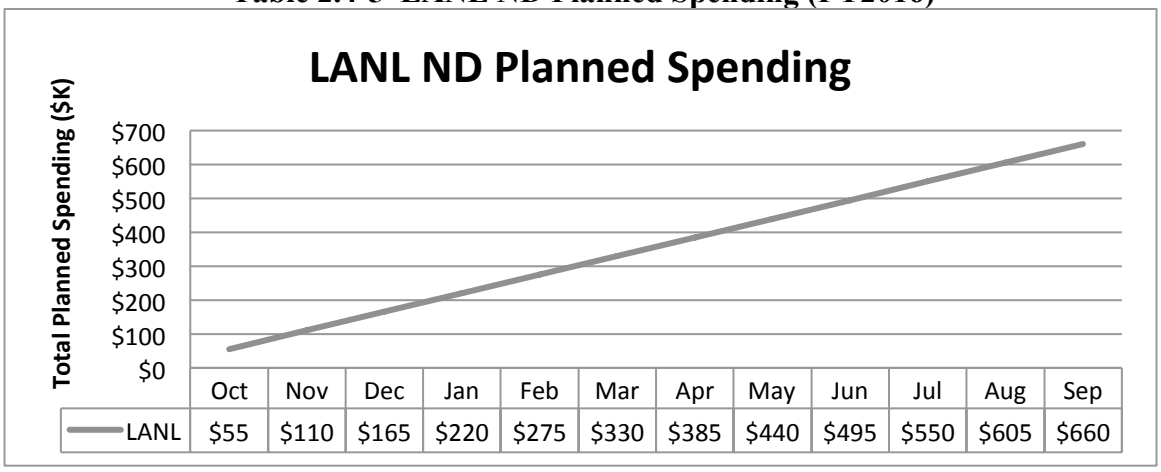


Table 2.4-5 LANL ND Planned Spending (FY2016)



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LANL	$55	$110	$165	$220	$275	$330	$385	$440	$495	$550	$605	$660

LANL ND Milestones:

Occurs all 4 Quarters

- Provide status reports on LANL participation in US and International Nuclear Data collaborations in NCSP Quarterly Progress Reports (ND1: All Qtrs).

Quarter 1

- Conduct annual NDAG meeting (ND2: Q1).
- Report data testing results with beta versions of ENDF/B-VII.1 and ICSBEP benchmarks (ND1: Q1).

Quarter 3

- Report data testing results with beta versions of ENDF/B-VII.1 and ICSBEP benchmarks (ND1: Q3).

Quarter 4

- Deliver nuclear data evaluations as indicated in Appendix B of the 5-Year Plan (ND1: Q4).
- Coordinate the annual update to the NCSP nuclear data work schedule in the Five-Year Plan (ND2: Q4).

EOC – for out-year peaks and dips in budget plots:

Increase in funding in out-years to ramp up Nuclear Data Testing planned per Appendix B and as defined in the NCSP Mission and Vision document.

2.4.2.3 Lawrence Livermore National Laboratory (LLNL)

LLNL ND1 ($0K) [IRSN Area of Collaboration (See Appendix E**)]**
This is an ongoing approved task to work with IRSN to develop a first principles analytic method to determine the equilibrium and time-dependent emission of delayed gammas based on event-by-event modeling of the fission process and subsequent fission product decay. This task supports continued data testing as new experimental data becomes available from foil activation measurements and dosimetry testing using GODIVA, FLATTOP and COMET. This is a task that has a dual benefit and links the ND and IE program elements. Funding for this task is included in LLNL IE1. As the IE experimental work is performed, IRSN and LLNL will be able to provide time-dependent emission data for delayed gammas. The task is identified under ND to show the linkage with the IE element.

LLNL ND2 ($75K)
This is an ongoing approved task in collaboration with NCSU to refine and complete basic atomistic models for executing molecular dynamics simulations for polymethyl methacrylate ($C_5H_8O_2$, trademark names: Lucite, Perspex, Plexiglas). A potential function describing the atomistic interactions will be chosen and parameterized to reproduce its observed characteristics. Subsequently, the excitation spectrum (i.e., vibrations, rotations, etc.) will be calculated. This information will be used to develop LEAPR-THERMR modules in NJOY to calculate the scattering law, $S(\alpha,\beta)$, and the thermal neutron scattering cross sections at temperatures of interest. The libraries produced will account for both inelastic and coherent elastic scattering, when applicable. With LLNL assistance, these $S(\alpha,\beta)$ libraries in both ENDF File 7 and ACE ("A Compact ENDF" file) formats will be tested in COG using relevant criticality safety benchmarks selected from the ICSBEP Handbook. Finally, the $S(\alpha,\beta)$ libraries in ENDF File 7 will be provided to the National Nuclear Data Center at Brookhaven National Laboratory. Additionally, work will begin for calculating the scattering law, $S(\alpha,\beta)$, and the thermal neutron scattering cross sections for polyethylene (CH_2).

LLNL ND3 ($75K)
This is new approved task in collaboration with NCSU to develop a "next generation" computational platform for calculating thermal neutron scattering cross sections and to assist in interpreting and processing related measured data. This tool will be based on rigorous physics and will abandon all simplifications such as the incoherent, cubic and Gaussian approximations that are implemented in current computer codes. In addition, it will include the option to accept as input phonon frequency spectra (as in the current practice), full dispersion relations (as needed to address strong coherent scattering materials such as carbon and beryllium), velocity autocorrelation functions (as the starting point for describing liquids and non-crystalline materials), and/or the van Hove correlation function (i.e., $G(\mathbf{r},t)$) for exact calculations of the full $S(\alpha,\beta)$ of a given material including the self and distinct components. Furthermore, advanced, physics based $S(\alpha,\beta)$ interpolation free analysis methods will be investigated. For completeness, the code will include a generalized capability for calculating the coherent elastic scattering cross section for crystalline materials that addresses any material and structure as specified by the user. Finally, method specific formulations for estimating covariance information for the data will be explored and included.

Table 2.4-6 LLNL ND Budget Trend (FY2016-FY2020)

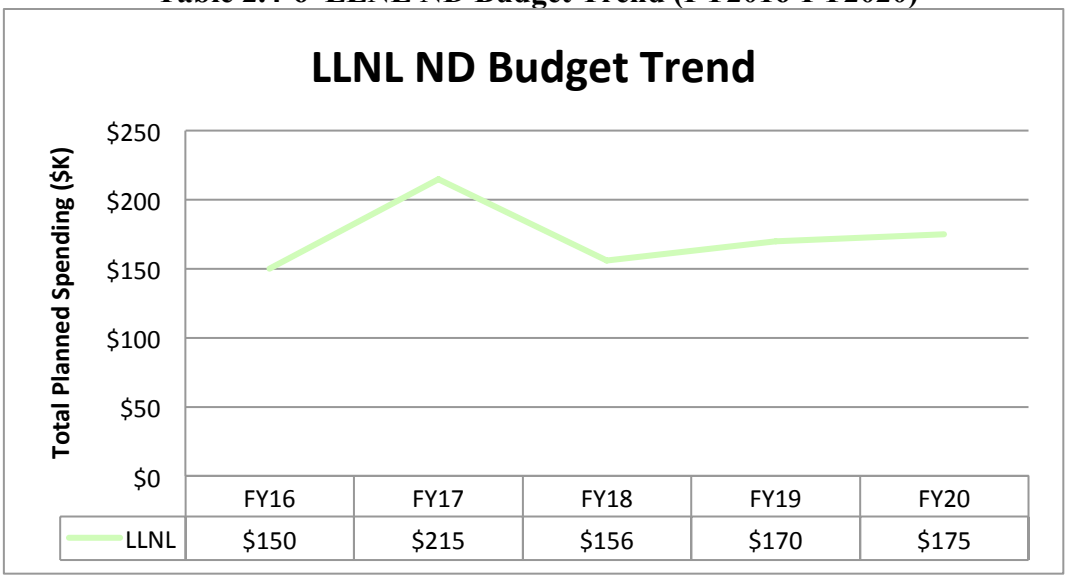
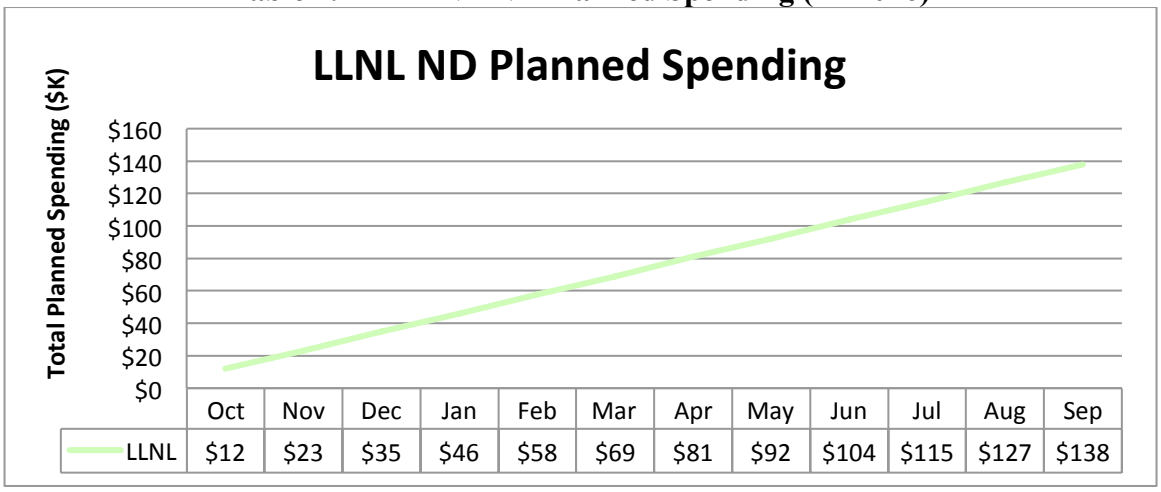


Table 2.4-7 LLNL ND Planned Spending (FY2016)



* LLNL Planned Spending reduced by approximately 8% to account for required laboratory hold-back during FY CR funding uncertainty.

LLNL ND Milestones:

Occurs all 4 Quarters

- Provide status on LLNL/NCSU nuclear data activities to NCSP Manager (ND2, ND3: All Qtrs).

Quarter 4

- Deliver thermal neutron scattering data evaluations as indicated in Appendix B of the 5-Year Plan (ND2: Q4).

EOC – for out-year peaks and dips in budget plots:

Increase in funding in FY17 to support the one-year Delayed Fission Gamma Multiplicity and Spectra task. Very modest increases in out-years to help mitigate increased cost of doing business.

2.4.2.4 Oak Ridge National Laboratory (ORNL)

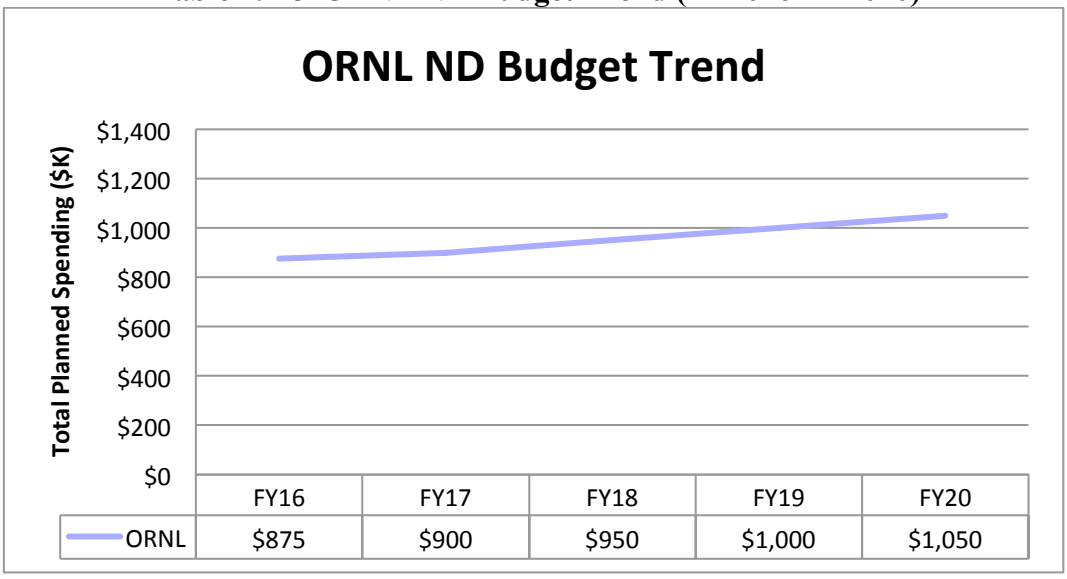
ORNL ND1 ($850K) [IRSN Area of Collaboration (See Appendix E)]

This is an ongoing approved task to conduct nuclear data measurements at IRMM and RPI and perform nuclear data evaluation activities in support of the NCSP. This subtask continues to primarily focus on the resonance-region and includes cross-section measurements and the production of new cross-section evaluations with covariance data. The ORNL nuclear data measurements and evaluations are performed in accordance with the milestone schedule in Appendix B.

ORNL ND4 ($25K)

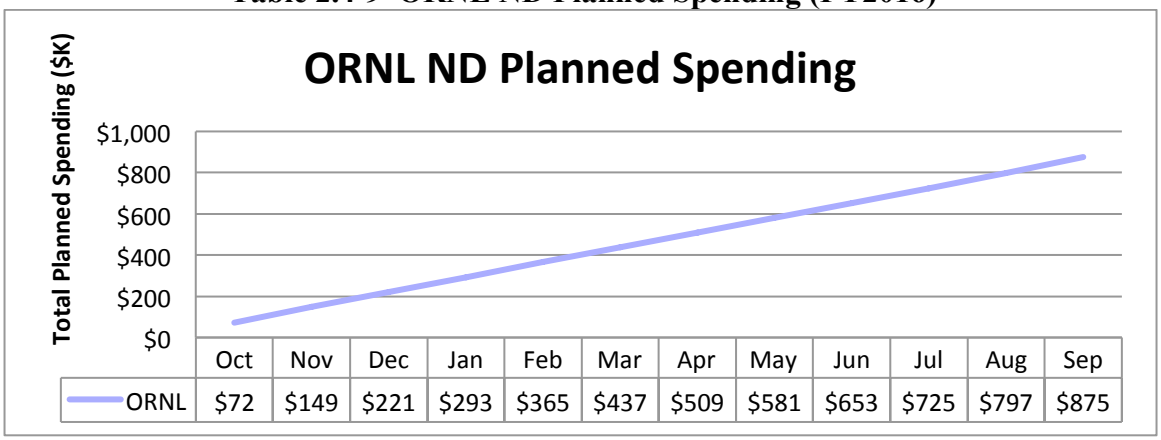
This is an ongoing approved task to develop nuclear data evaluation capabilities to analyze thermal neutron scattering measurements to produce new cross-section evaluations for thermal moderators. This task is being performed in collaboration with RPI who is tasked to perform double differential thermal scattering measurements.

Table 2.4-8 ORNL ND Budget Trend (FY2016-FY2020)



	FY16	FY17	FY18	FY19	FY20
ORNL	$875	$900	$950	$1,000	$1,050

Table 2.4-9 ORNL ND Planned Spending (FY2016)



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
ORNL	$72	$149	$221	$293	$365	$437	$509	$581	$653	$725	$797	$875

ORNL ND Milestones:

Occurs all 4 Quarters

- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND1, ND4: All Qtrs).
- Provide status reports on ORNL participation in US and International Nuclear Data collaborations, and for foreign travel, provide a brief trip summary report to NCSP Manager on items of NCSP interest (ND1: All Qtrs).
- Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B (ND1: All Qtrs).

Quarter 4

- Develop prototypic methodology to analyze measured thermal neutron scattering data for supporting the development of a thermal cross-section evaluation capability (ND4: Q4).

EOC – for out-year peaks and dips in budget plots:

Increases in out-years for support of Nuclear Data Testing planned per Appendix B and as defined in the NCSP Mission and Vision document.

2.4.2.5 Renssalaer Polytechnic Institute (RPI)

RPI ND1 ($330K)

This is an ongoing approved task in collaboration with ORNL to support the resonance region Nuclear Data Measurement Capability at RPI and to perform cross-section measurements and qualification of the new capabilities.

RPI ND2 ($120K)

This is an ongoing approved task in collaboration with ORNL to support the thermal Neutron Scattering Measurement for Improvement of Criticality Calculations and Propagation of Scattering Kernel Uncertainties. This task also supports the work to broaden and maintain the U.S. capabilities to support NCSP experimental nuclear data needs by providing priority NCSP thermal scattering law data.

RPI ND3 ($1000K)

This is an ongoing approved task to support the RPI/ORNL: Linear Accelerator (LINAC) 2020 Nuclear Data Capabilities Maintenance Plan in collaboration with Naval Reactors (NA-30) who is co-funding 2/3 of the total refurbishment costs. In order to be able to continue to deliver a reliable neutron beam with the proper conditions required for these experiments, a long-term maintenance and update plan is being implemented.

Table 2.4-10 RPI ND Budget Trend (FY2016-FY2020)

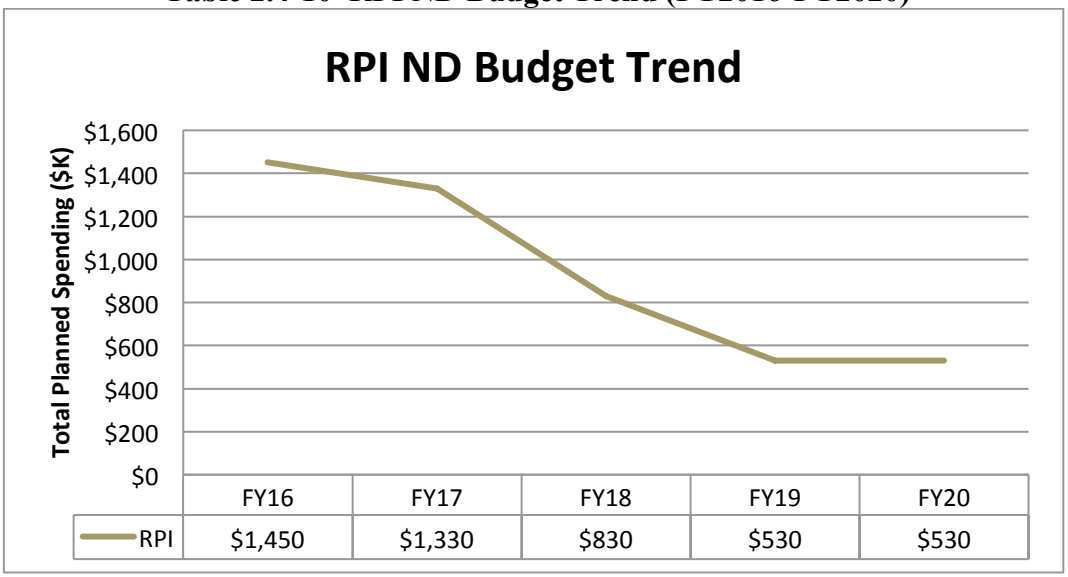
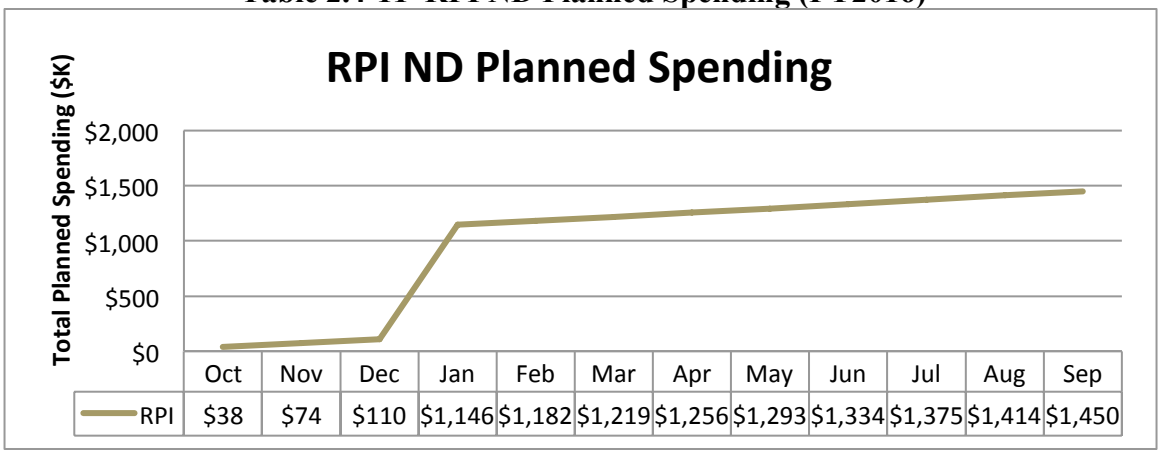


Table 2.4-11 RPI ND Planned Spending (FY2016)



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
RPI	$38	$74	$110	$1,146	$1,182	$1,219	$1,256	$1,293	$1,334	$1,375	$1,414	$1,450

RPI ND Milestones:

Occurs all 4 Quarters

- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND1, ND2, ND3: All Qtrs).
- Provide status reports on RPI participation in US and International Nuclear Data collaborations, and for foreign travel, provide a brief trip summary report to NCSP Manager on items of NCSP interest (ND1: All Qtrs).

Quarter 1

- Initiate modulator purchase in coordination with NR (ND3: Q1).

Quarter 3

- Complete transmission measurement with ORNL sample per the nuclear data schedule in Appendix B (ND1: Q3).
- Complete capture measurement per the nuclear data schedule in Appendix B (ND1: Q3).
- Perform thermal scattering measurements per the nuclear data schedule in Appendix B (ND2: Q3).

Quarter 4

- Complete data analysis for transmission and capture measurements and provide data to ORNL as needed to support the evaluation effort per the nuclear data schedule in Appendix B (ND1: Q4).
- Complete thermal scattering measurement and data analysis and provide data to ORNL as needed to support the evaluation effort per the nuclear data schedule in Appendix B (ND2: Q4).

EOC – for out-year peaks and dips in budget plots:

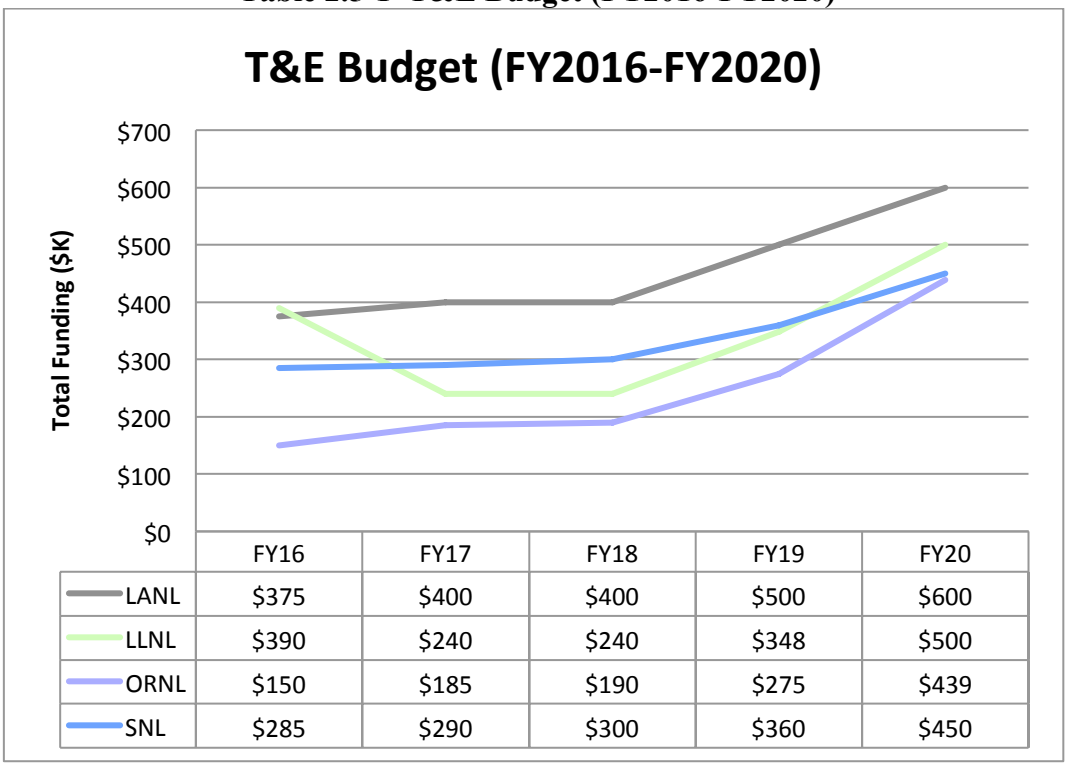
High funding level tapering off in FY16-18 supports the RPI LINAC 2020 Nuclear Data Capabilities Maintenance Plan co-funded by Naval Reactors for an initial investment period of approximately 3 years with a decrease of funding at the end of that investment period.

2.5 Training and Education (T&E)

2.5.1 Program Element Description

The Training and Education program element continues to offer hands-on training courses as needed by DOE and identify training needs and develop training resources in areas where no suitable materials exist. The primary purpose of the T&E element is to maintain the technical capabilities of criticality safety professionals and provide for the training and education of people entering the criticality safety discipline from related scientific fields. A significant portion of the T&E work effort is to provide both the 2-week hands-on criticality safety courses for criticality safety engineers and 1-week hands-on criticality safety courses for supervisors and managers.

Table 2.5-1 T&E Budget (FY2016-FY2020)



	FY16	FY17	FY18	FY19	FY20
LANL	$375	$400	$400	$500	$600
LLNL	$390	$240	$240	$348	$500
ORNL	$150	$185	$190	$275	$439
SNL	$285	$290	$300	$360	$450

2.5.2 Approved Tasks

2.5.2.1 Los Alamos National Laboratory (LANL)

LANL T&E1 ($375K)

This is an ongoing approved task to conduct criticality safety hands-on training at NCERC according to an integrated schedule developed by ORNL and approved by the NCSP manager.

Table 2.5-2 LANL T&E Budget Trend (FY2016-FY2020)

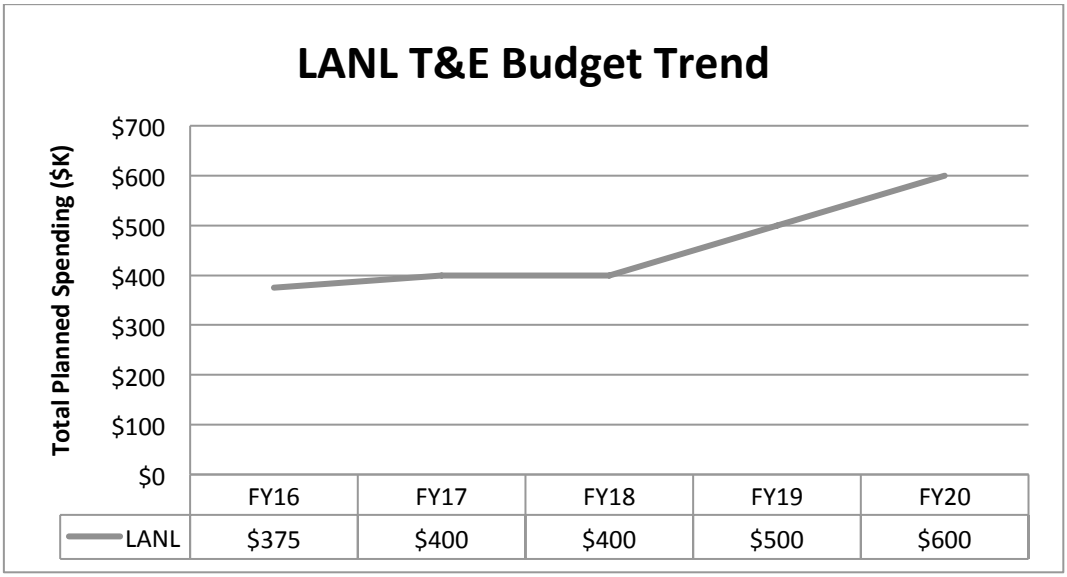
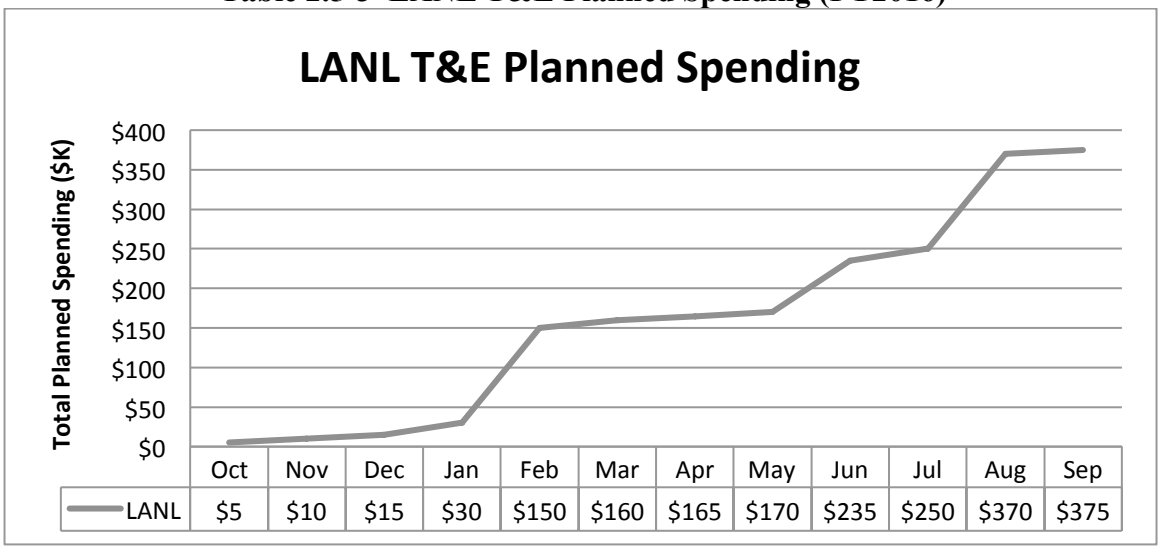


Table 2.5-3 LANL T&E Planned Spending (FY2016)



LANL T&E Milestones:

Occurs all 4 Quarters

- Provide training in accordance with the approved schedule and provide status reports on all training activities to the NCSP Manager (TE1: All Qtrs).

EOC – for out-year peaks and dips in budget plots:

Increase in funding in FY17 to support the relocation of the classroom training to LANL. Very modest increases in out-years to help mitigate increased cost of doing business.

2.5.2.2 Lawrence Livermore National Laboratory (LLNL)

LLNL T&E1 ($240K)

This is an ongoing approved task to provide unique "hands-on" training at the Device Assembly Facility (DAF) using the Training Assembly for Criticality Safety (TACS). This task also supports continued LLNL coordination of the course registration process for all courses at NSF, NCERC and SNL.

LLNL T&E3 ($150K)

This is a new approved task to provide increased LLNL support for FY2016 classroom instruction at the Nevada Site Facility and participation in T&E transition activities.

Table 2.5-4 LLNL T&E Budget Trend (FY2016-FY2020)

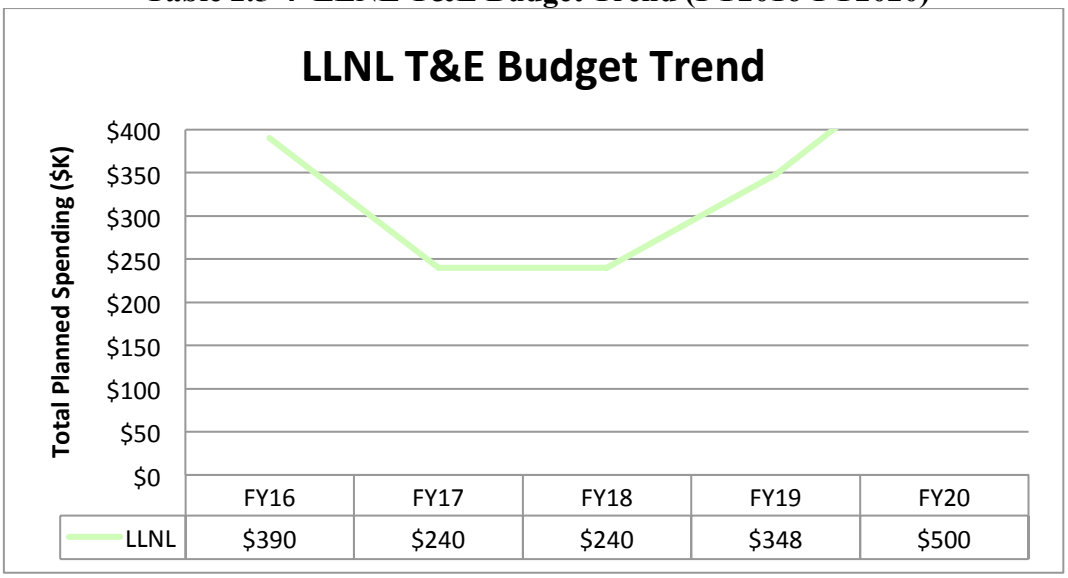
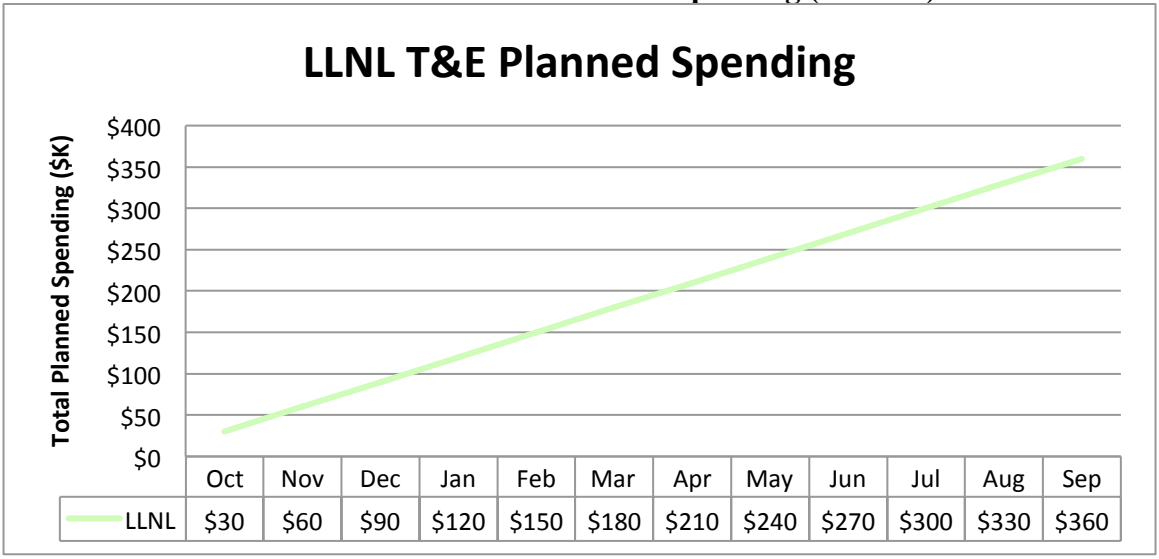


Table 2.5-5 LLNL T&E Planned Spending (FY2016)*



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LLNL	$30	$60	$90	$120	$150	$180	$210	$240	$270	$300	$330	$360

* LLNL Planned Spending reduced by approximately 8% to account for required laboratory hold-back during FY CR funding uncertainty.

LLNL T&E Milestones:

Occurs all 4 Quarters

- Update, maintain and support the registration process and provide classroom and "hands on" TACS training in accordance with the schedule approved by the NCSP Manager (TE1: All Qtrs).
- Provide increased LLNL support for FY2016 classroom instruction at the Nevada Site Facility and participation in T&E transition activities in accordance with the schedule approved by the NCSP Manager (TE2: All Qtrs).

EOC – for out-year peaks and dips in budget plots:

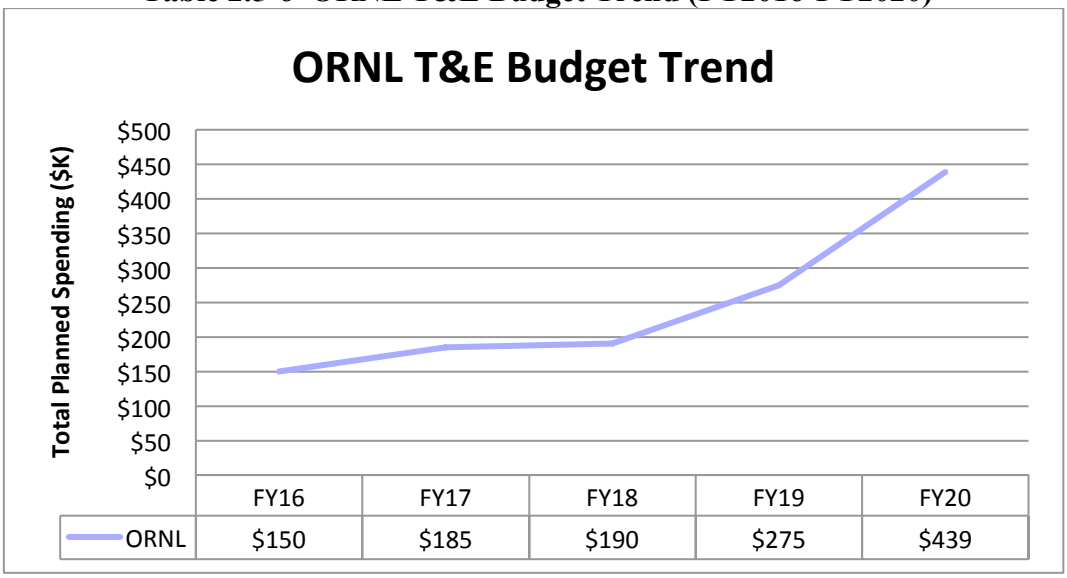
Decrease in Fiscal Year (FY) 17 due to possible relocation of classroom training with modest increases in out-years to help mitigate increased cost of doing business.

2.5.2.3 Oak Ridge National Laboratory (ORNL)

ORNL T&E1 ($150K)

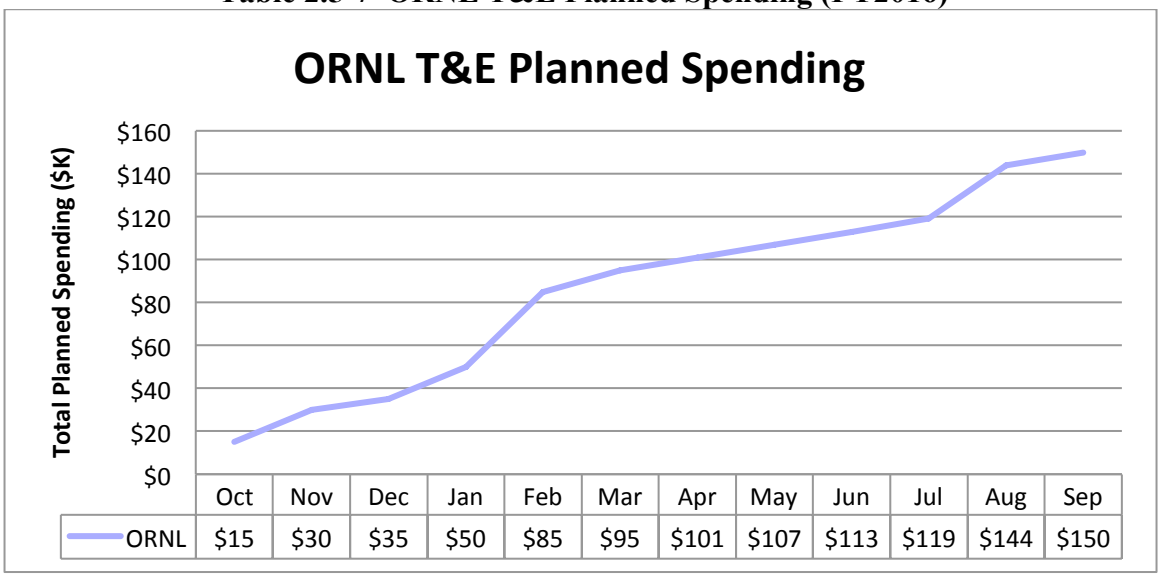
This is an ongoing approved task to manage the collaborative multi-laboratory development, designing, and scheduling of the multi-faceted and phased NCSP training program and oversee the execution of the program. The task also includes support for an ORNL nondestructive assay (NDA) expert to providing training on NDA measurement capabilities as part of the NCSP training courses.

Table 2.5-6 ORNL T&E Budget Trend (FY2016-FY2020)



	FY16	FY17	FY18	FY19	FY20
ORNL	$150	$185	$190	$275	$439

Table 2.5-7 ORNL T&E Planned Spending (FY2016)



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
ORNL	$15	$30	$35	$50	$85	$95	$101	$107	$113	$119	$144	$150

ORNL T&E Milestones:

Occurs all 4 Quarters

- Provide status reports in NCSP Quarterly Progress Reports on implementation of the NCS training program (TE1: All Qtrs).
- Provide status reports in NCSP Quarterly Progress Reports on improvements/modifications to baseline NCS course training materials based on self-evaluation and feedback from reviewers, observers, trainers, and the NCSP manager (TE1: All Qtrs).

EOC – for out-year peaks and dips in budget plots:

Increase in FY17 to return funding to expected spend rate for 4 classes or more per year with modest increases in out-years to help mitigate increased cost of doing business.

2.5.2.4 Sandia National Laboratories (SNL)

SNL T&E1 ($285K)

This is an ongoing approved task to conduct criticality safety training classes at SNL according to an integrated schedule developed by ORNL and approved by the NCSP Manager. Provide Human Factors and Equipment Reliability module support to the training class.

Table 2.5-8 SNL T&E Budget Trend (FY2016-FY2020)

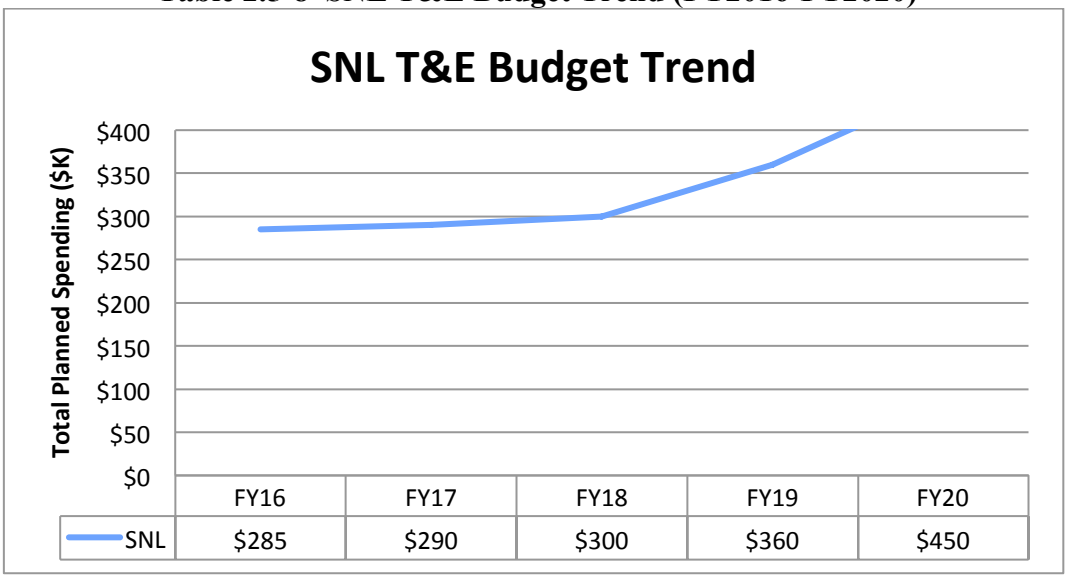
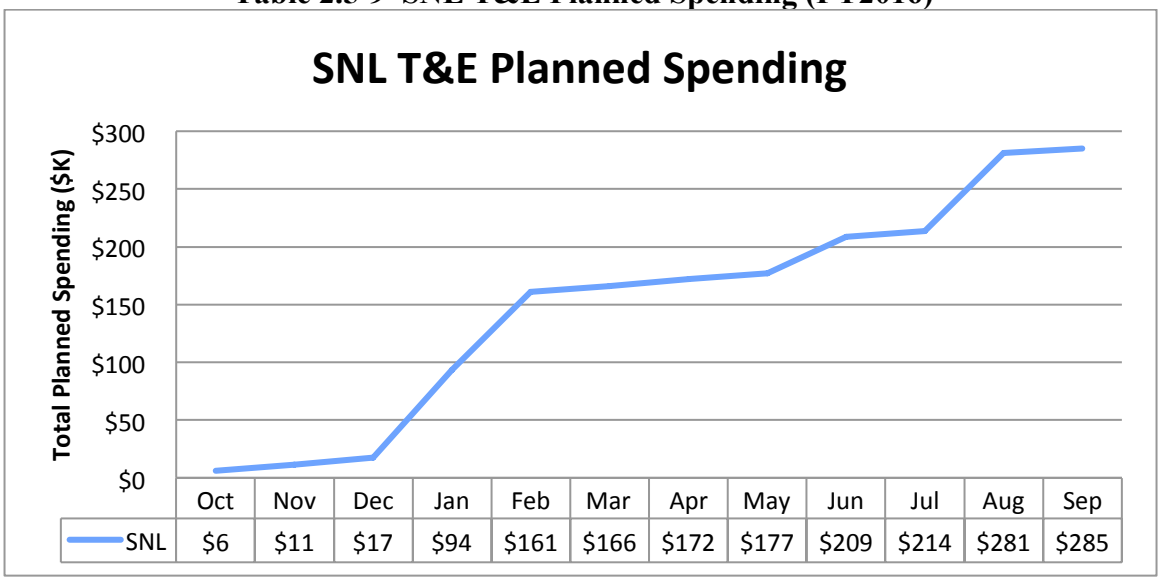


Table 2.5-9 SNL T&E Planned Spending (FY2016)



SNL T&E Milestones:

All Quarters

- Conduct hands-on training classes at Sandia and provide Human Factors and Equipment Reliability module support to the training classes in accordance with the approved schedule (TE1: All Qtrs).

EOC – for out-year peaks and dips in budget plots:

Very modest increases in out-years to help mitigate increased cost of doing business.

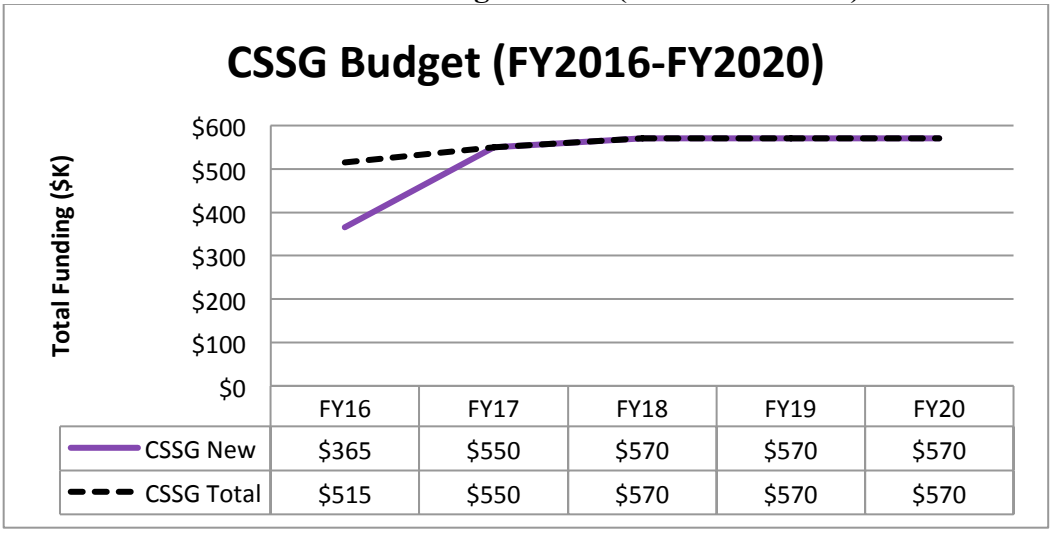
3.0 Criticality Safety Support Group (CSSG)

The CSSG is comprised of recognized criticality safety experts from DOE offices and contractor organizations. The primary function of the CSSG is to provide operational and technical expertise to the DOE through the NCSP Manager. The CSSG also provides the NCSP Manager with technical reviews of orders, standards, rules, and guides issued by DOE related to criticality safety. In addition, the CSSG responds to requests from the NCSP Manager for information, technical reviews, and evaluations of criticality safety issues throughout the complex. The CSSG receives modest support for its contractor members (nine CSSG contractor members' $50K/member + $25K for the CSSG Chair + $25K for the CSSG Deputy Chair).

NCSP TS1 ($365K)

This is an ongoing approved task to provide Technical Support as tasked by NCSP Manager through approved CSSG Taskings as found on the NCSP Website.

Table 3.1 CSSG Budget Trend (FY2016-FY2020)*



	FY16	FY17	FY18	FY19	FY20
CSSG New	$365	$550	$570	$570	$570
CSSG Total	$515	$550	$570	$570	$570

* FY16 $365K is a reduction from the prior plan, due to available FY15 carryover funds.

4.0 NCSP Technical Support

NCSP Technical Support to assist the NCSP Management Team in the program management and execution of the NCSP and funding for the succession planning of key program elements as defined in the 10-year Mission and Vision.

NCSP TS2 ($600K) - ORNL

This is an ongoing approved task for ORNL to support the DOE NCSP Management in the program management and execution of the NCSP. ORNL is the Lead Laboratory for the NCSP infrastructure being responsible for the annual updates for the 5-year plan and the annual activities of the NCSP in supporting the NNSA PPBE cycle at the direction and supervision of the NCSP manager.

NCSP TS3 ($50K) - SNL

In accordance with the ten-year Mission and Vision, the NCSP has identified the need to develop and implement succession plans for key staff expert capabilities to support continued execution of the NCSP Mission. At SNL, there is a need to maintain the integral experiment expertise using the SNL critical experiment capabilities. The work associated with this task is to develop and execute IE Succession Planning for new experimentalists at SNL.

NCSP TS4 ($100K) - LANL

In accordance with the ten-year Mission and Vision, the NCSP has identified the need to develop and implement succession plans for key staff expert capabilities to support continued execution of the NCSP Mission. There is a need to maintain expertise in the analytical methods, integral experiments and nuclear data capabilities that currently exist at LANL. The work associated with this task is to develop and execute AM, IE, and ND Succession Planning at LANL as defined in the NCSP Mission and Vision document for cross-section processing developers, radiation transport methods developers, experimentalists, and nuclear data evaluators.

NCSP TS5 ($100K) - LLNL

In accordance with the ten-year Mission and Vision, the NCSP has identified the need to develop and implement succession plans for key staff expert capabilities to support continued execution of the NCSP Mission. There is a need to maintain expertise in the analytical methods and integral experiment capabilities that currently exist at LLNL. The work associated with this task is to develop and execute AM and IE Succession Planning at LLNL as defined in the NCSP Mission and Vision document for integral experiment equipment Support, facility support, and radiation transport methods developers.

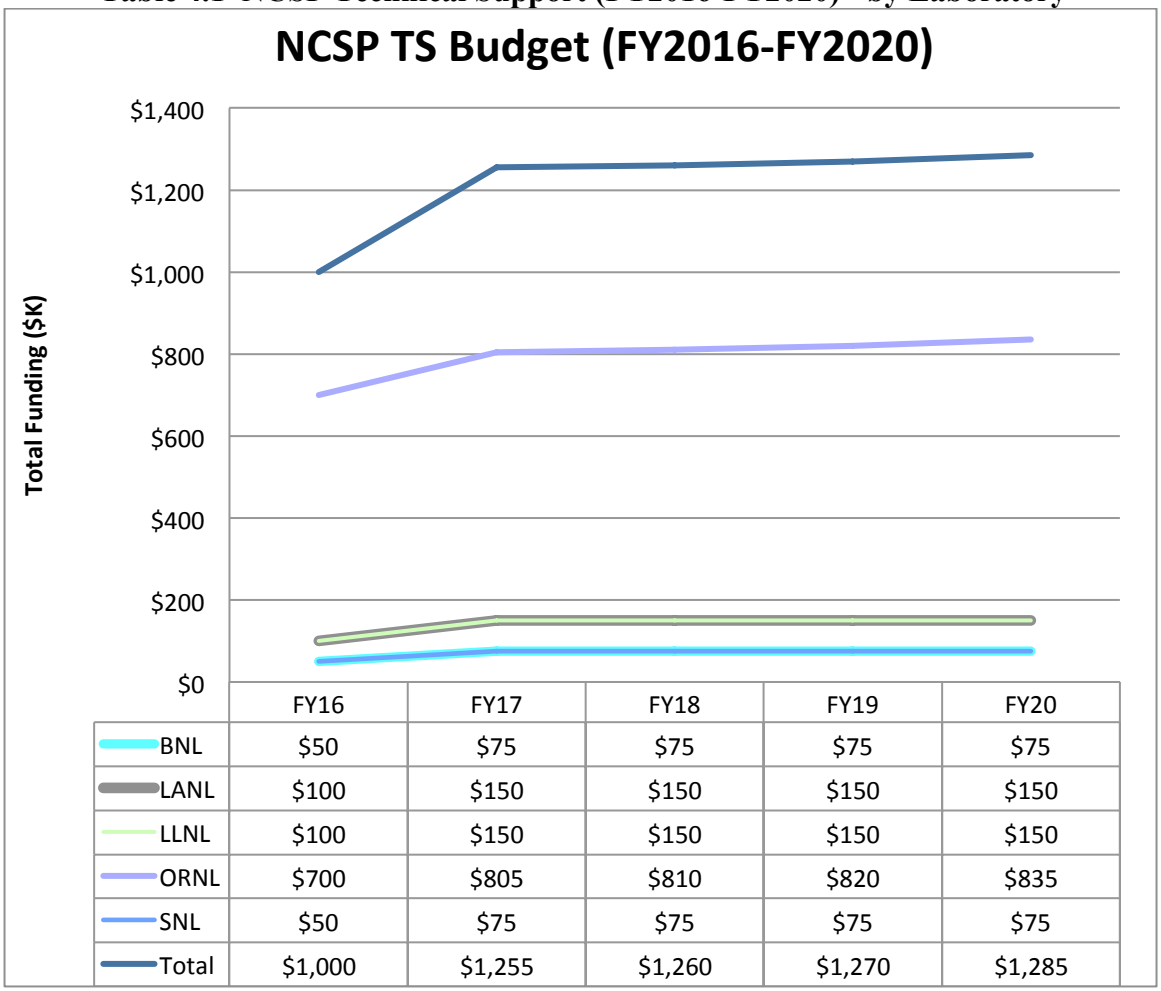
NCSP TS6 ($50K) - BNL

In accordance with the ten-year Mission and Vision, the NCSP has identified the need to develop and implement succession plans for key staff expert capabilities to support continued execution of the NCSP Mission. There is a need to maintain expertise in the nuclear data analysis capabilities that currently exist at BNL. The work associated with this task is to develop and execute ND Succession Planning at BNL as defined in the NCSP Mission and Vision document for nuclear data analysis capabilities needed to support operations at the National Nuclear Data Center.

NCSP TS7 ($100K) - ORNL

In accordance with the ten-year Mission and Vision, the NCSP has identified the need to develop and implement succession plans for key staff expert capabilities to support continued execution of the NCSP Mission. There is a need to maintain expertise in the nuclear data evaluation capabilities that currently exist at ORNL. The work associated with this task is to address key nuclear data evaluator succession planning needs for the NCSP. As part of this task, a post-doctoral staff member will work with an ORNL nuclear data evaluation specialist to complete NCSP nuclear data evaluation work tasks thereby training the next generation of nuclear data experts to perform neutron resonance analyses for the NCSP.

Table 4.1 NCSP Technical Support (FY2016-FY2020) - by Laboratory



	FY16	FY17	FY18	FY19	FY20
BNL	$50	$75	$75	$75	$75
LANL	$100	$150	$150	$150	$150
LLNL	$100	$150	$150	$150	$150
ORNL	$700	$805	$810	$820	$835
SNL	$50	$75	$75	$75	$75
Total	$1,000	$1,255	$1,260	$1,270	$1,285

NCSP TS Milestones:

Occurs all 4 Quarters

- Manage C_EdT process and coordinate execution of planned IERs each FY (TS2: All Qtrs).
- Maintain up-to-date spreadsheet of proposed tasks for NCSP Manager after the NCSP proposal review meeting and through the final task prioritization effort by the NCSP Management Team (TS2: All Qtrs).

Quarter 4

- Participate in Q4 Budget Execution Meeting and assist NCSP Manager in finalization of approved tasks for next FY (TS2: Q4).
- Publish final Five-Year Plan (TS2: Q4).
- Provide NCSP Manager annual report of succession planning efforts (TS3, TS4, TS5, TS6, TS7: Q4).

EOC – for out-year peaks and dips in budget plots:

Increase in FY17 to return funding level to expected need levels for succession planning.

Appendix A

Work Authorization Statements for Nuclear Criticality Safety Program Funding for Execution Year FY2016 Provided to the NA-50 Budget Office in October 2015

Argonne National Laboratory (ANL): $10K

Task: Criticality Safety Support Group

Reflects funds for participation in the Criticality Safety Support Group (CSSG), as it provides technical support to the Nuclear Criticality Safety Program (NCSP) Manager regarding planning and execution of the NCSP.

ANL POC: Jim Morman (630-252-6076), jamorman@anl.gov
DOE POC: Jerry McKamy, NNSA (301-903-7980)

Brookhaven National Laboratory (BNL): $200K

Task: Nuclear Data

Reflects funds to continue supporting nuclear data activities, including shepherding new data evaluations through the Cross Section Evaluation Working Group (CSEWG) process, subsequent publication of these data in the United States Evaluated Nuclear Data File (ENDF), and nuclear data succession planning, as delineated in the Nuclear Criticality Safety Program (NCSP) FY16 Five-Year Plan dated October 2015, or as directed by the NCSP Manager.

BNL POC: David Brown (631-344-2814), dbrown@bnl.gov
DOE POC: Jerry McKamy, NNSA (301-903-7980)

Los Alamos National Laboratory (LANL): $10,642K

Tasks: Analytical Methods, Integral Experiments, Nuclear Data, Training and Education, and the Criticality Safety Support Group

Reflects funds to continue analytical methods; integral experiments; nuclear data; and training and education support, as delineated in the Nuclear Criticality Safety Program (NCSP) FY16 Five-Year Plan dated October 2015, or as directed by the NCSP Manager; succession planning for Cross-Section processing developers, Radiation transport developers, Experimentalists, and/or Nuclear Data developers/evaluators; and for participation in the Criticality Safety Support Group (CSSG), as it provides technical support to the NCSP Manager regarding planning and execution of the NCSP.

LANL POC: Robert Margevicius (505-665-8965), margevicius@lanl.gov
DOE POC: Jerry McKamy, NNSA (301-903-7980)

Lawrence Livermore National Laboratory (LLNL): $3,170K

Tasks: Analytical Methods, Information Preservation and Dissemination, Integral Experiments, Nuclear Data, Training and Education, and the Criticality Safety Support Group

Reflects funds to continue support for analytical methods; information preservation and dissemination; integral experiments; nuclear data; training and education, as delineated in the Nuclear Criticality Safety Program (NCSP) FY16 Five-Year Plan dated October 2015, or as directed by the NCSP Manager; succession planning for Equipment Support, Facility support, and/or Radiation transport developers; and for participation in the Criticality Safety Support Group (CSSG), as it provides technical support to the NCSP Manager regarding planning and execution of the NCSP.

LLNL POC: David Heinrichs (925-424-5679), heinrichs1@llnl.gov
DOE POC: Jerry McKamy, NNSA (301-903-7980)

Nevada National Security Site - NSTec (NNSS): $3,918K

Task: Integral Experiments

Reflects funds to continue support for integral experiments, as delineated in the Nuclear Criticality Safety Program (NCSP) FY16 Five-Year Plan dated October 2015, or as directed by the NCSP Manager.

NNSS POC: Jeff Lewis (702-524-0647), lewisjm@nv.doe.gov
DOE POC: Jerry McKamy, NNSA (301-903-7980)

Oak Ridge National Laboratory (ORNL): $4,140K

Tasks: NCSP Technical Support, Analytical Methods, Information Preservation and Dissemination, Integral Experiments, Nuclear Data, and Training and Education

Reflects funds to continue support for analytical methods; information preservation and dissemination; integral experiments; nuclear data; and training and education, as delineated in the Nuclear Criticality Safety Program (NCSP) FY16 Five-Year Plan dated October 2015, or as directed by the NCSP Manager; Technical Support for NCSP management; and for succession planning for Cross-Section processing developers, Radiation transport developers, and/or Nuclear Data evaluators/experimentalists/developers.

Within available funds continue work on the new, modern NDA measurement system (SNAPSHOT) that ORNL has been working to complete for field deployment, support the TSG, perform NDA experiments, and perform NDA program management tasks as directed by the NNSA NDA Program Manager.

ORNL POC: Mike Dunn (865-574-5260), dunnme@ornl.gov
DOE POC: Jerry McKamy, NNSA (301-903-7980)

Renssalaer Polytechnic Institute (RPI): $1,450K

Task: Nuclear Data

Reflects funds to conduct differential measurements as delineated in the Nuclear Criticality Safety Execution (NCSP) FY16 Five-Year Plan dated October 2015 and continue work, as defined in the RPI LINAC 2020 Nuclear Data Capabilities Maintenance Plan, or as directed by the NCSP Manager.

RPI POC: Yaron Danon (518-276-4008), danony@rpi.edu
DOE POC: Jerry McKamy, NNSA (301-903-7980)

Sandia National Laboratories (SNL): $635K

Tasks: Integral Experiments and Training and Education

Reflects funds to continue support for integral experiments; training and education; and succession planning for experimentalists as, delineated in the Nuclear Criticality Safety Program (NCSP) FY16 Five-Year Plan dated October 2015, or as directed by the NCSP Manager.

SNL POC: Gary Harms (505-845-3244), gaharms@sandia.gov
DOE POC: Jerry McKamy, NNSA (301-903-7980)

Savannah River Site (SRS): $105K

Tasks: Information Preservation and Dissemination and the Criticality Safety Support Group

Reflects funds to update and maintain ARH-600 as delineated in the Nuclear Criticality Safety Program (NCSP) FY16 Five-Year Plan dated October 2015, or as directed by the NCSP Manager and for participation in the CSSG, as it provides technical support to the NCSP Manager regarding planning and execution of the NCSP.

SRS POC: David Erickson (803-557-9445), david.erickson@srs.gov
DOE POC: Jerry McKamy, NNSA (301-903-7980)

Y-12 National Security Complex (Y-12): $15K

Task: Criticality Safety Support Group

Reflects funds for participation in the Criticality Safety Support Group (CSSG), as it provides technical support to the Nuclear Criticality Safety Program (NCSP) Manager regarding planning and execution of the NCSP.

Y-12 POC: Kevin Kimball (865-576-6675), kevin.kimball@cns.doe.gov
DOE POC: Jerry McKamy, NNSA (301-903-7980)

Appendix B
Nuclear Data

Priority Needs */ Additional Needs	Thermal scattering (BeO, HF, D_2O, SiO_2, CH_2, C_2F_4, $C_5O_2H_8$, etc.), ^{239}Pu, Cr, ^{237}Np, Pb, ^{55}Mn, Ti, ^{240}Pu / ^{233}U, Th, Be, ^{51}V, Zr, F, K, Ca, Mo, Na, La
Completed Evaluations (FY)	Minor Actinides (13), SiO_2 (12), ^{55}Mn (12), ^{180,128,183,184,186}W (14)

	Materials	Pre FY2015	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	Post-FY2021
Measurements	Calcium (Ca)									
	Cerium (Ce)									
	Copper (Cu)									
	Iron (Fe)									
	Lucite ($C_5O_2H_8$)									
	Tantalum (Ta)									
	Strontium (Sr)									
	Tungsten (W)									
	Vanadium (V)									
	Zirconium (Zr)									
	Polyethylene (CH_2)	H_2O / CH_2								

	Materials	Pre FY2015	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	Post-FY2021
Complete Evaluations	Calcium (Ca)									
	Cerium (Ce)									
	Cobalt (Co)									
	Copper (Cu)									
	Dysprosium (Dy)									
	Gadolinium (Gd)									
	Iron (Fe)									
	Lead (Pb)									
	Nickel (Ni)									
	Oxygen (O)									
	Rhodium (Rh)									
	Plutonium-239									
	Tantalum (Ta)									
	Strontium (Sr)									
	Tungsten (W)									
	Uranium-235									
	Uranium-238									
	Vanadium (V)									
	Zirconium (Zr)									
	Hydrofluoric Acid									
	Lucite ($C_5O_2H_8$)									
	Polyethylene (CH_2)									
		ORNL		RPI		LANL		LLNL/NCSU		

- Requests for additional IE measurements: Ni, Mo, Cr (Fe-Cr alloys), Mn in intermediate energy range (VNIITF, NCERC).
- Request for measurements and evaluation of angular distributions at high energy for Cu.
- Continuing need for thermal scattering data.

***Note: work has been completed for some priority needs (e.g., ^{55}Mn, Ti, and Cr), and these isotopes/nuclides are maintained on the list for reference. Furthermore, the table represents the list of materials that can be addressed during the next five years under the current budget target. The additional priority needs will be addressed beyond the next five years.**

B-1 Differential Measurements and Evaluations – Elements
(The following list provides the specific GANTT chart to refer to for each element work schedule)

B-1.1 Calcium (Ca)
B-1.2 Cerium (Ce)
B-1.3 Cobalt (Co-59)
B-1.4 Dysprosium (Dy-161, 162, 163, 164)
B-1.5 Gadolinium (Gd-155, 156, 157, 158, 160)
B-1.6 Iron (Fe-54, 56)
B-1.7 Lead (Pb-208)
B-1.8 Oxygen (O-16)
B-1.9 Rhodium (Rh-103)
B-1.10 Plutonium (Pu-239)
B-1.11 Strontium (Sr)
B-1.12 Tantalum (Ta)
B-1.13 Uranium (U-235)
B-1.14 Uranium (U-238)
B-1.15 Vanadium (V-51)
B-1.16 Zirconium (Zr-90, 91, 92, 94, 96)

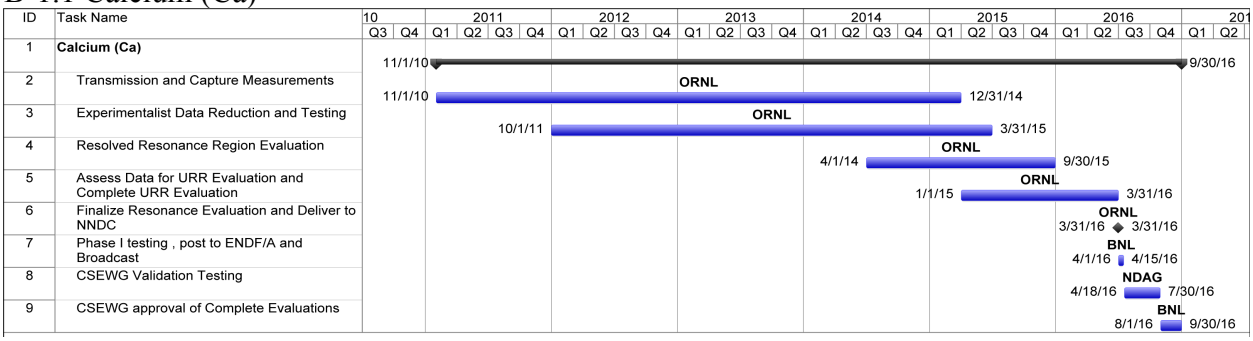
Completed Work

B-1.17 Copper (Cu-63, 65)
B-1.18 Nickel (Ni-58, 60)
B-1.19 Tungsten (W-182, 183, 184, 186)

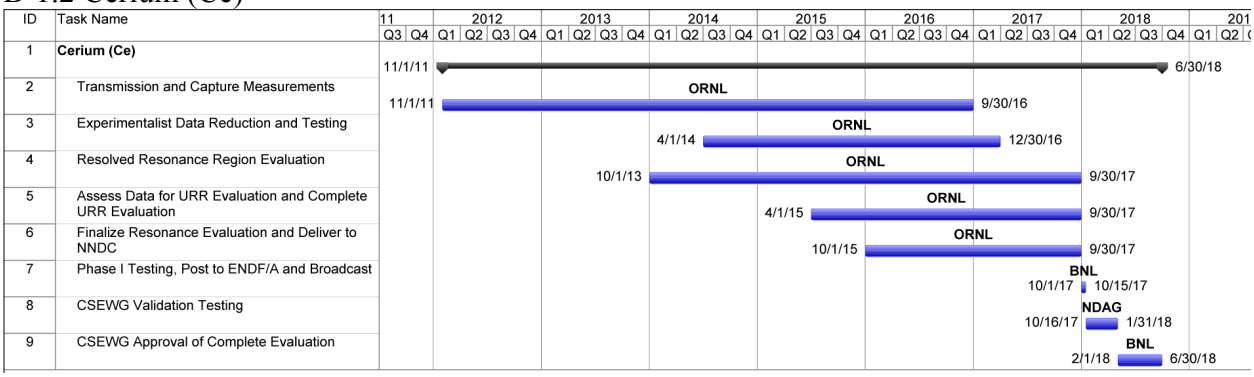
B-2 Differential Measurements and Evaluations – Compounds

B-2.1 Hydrofluoric Acid (HF)
B-2.2 Lucite (**$C_5O_2H_8$**)
B-2.3 Polyethylene (CH_2)

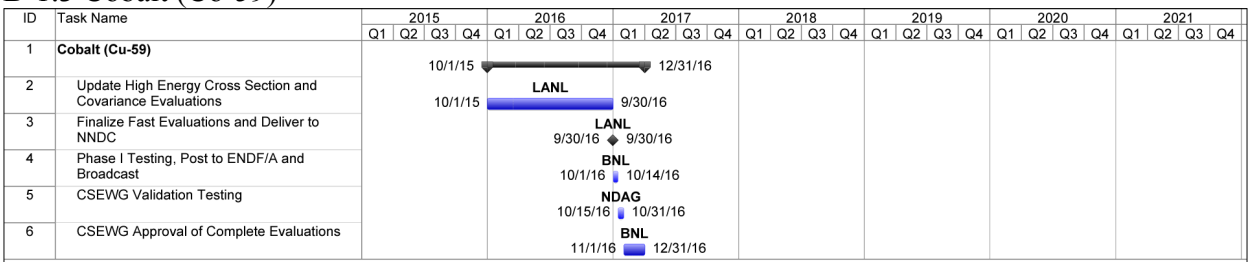
B-1.1 Calcium (Ca)



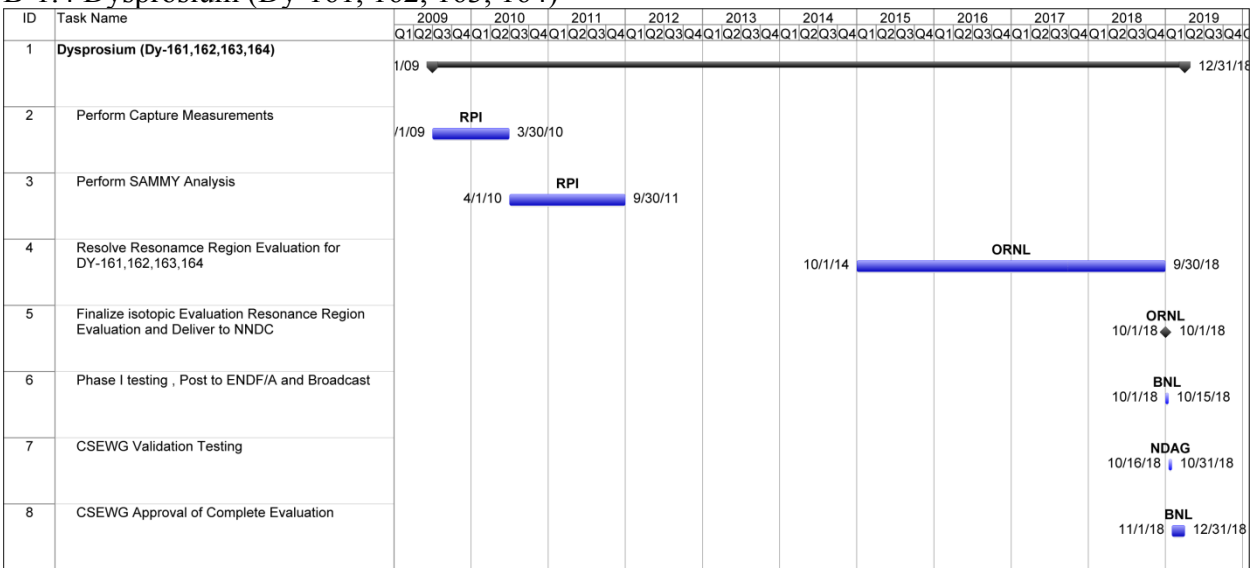
B-1.2 Cerium (Ce)



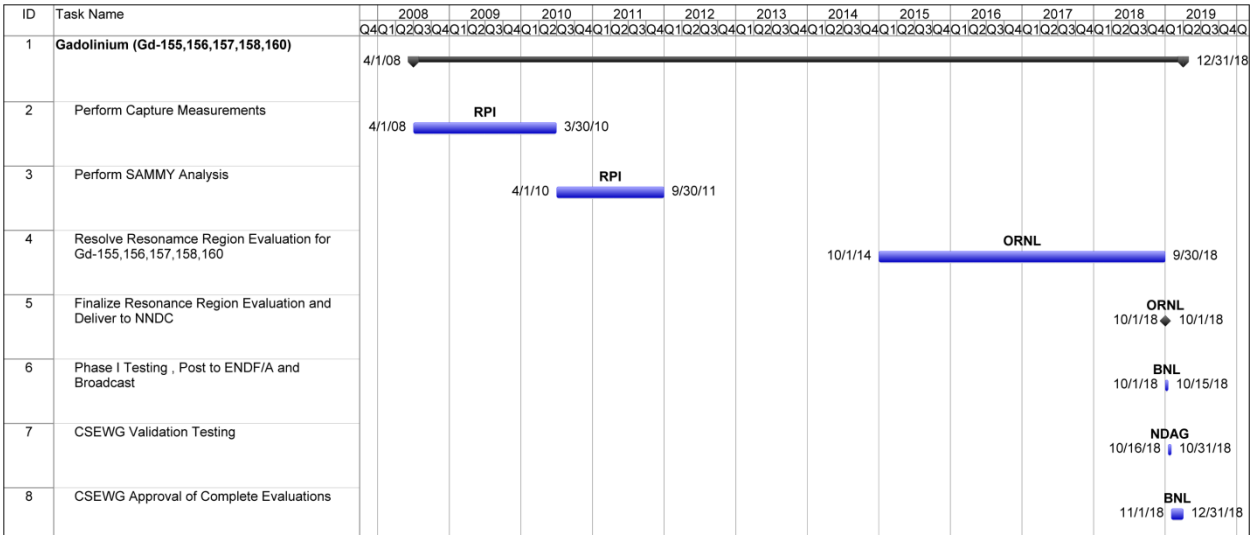
B-1.3 Cobalt (Co-59)



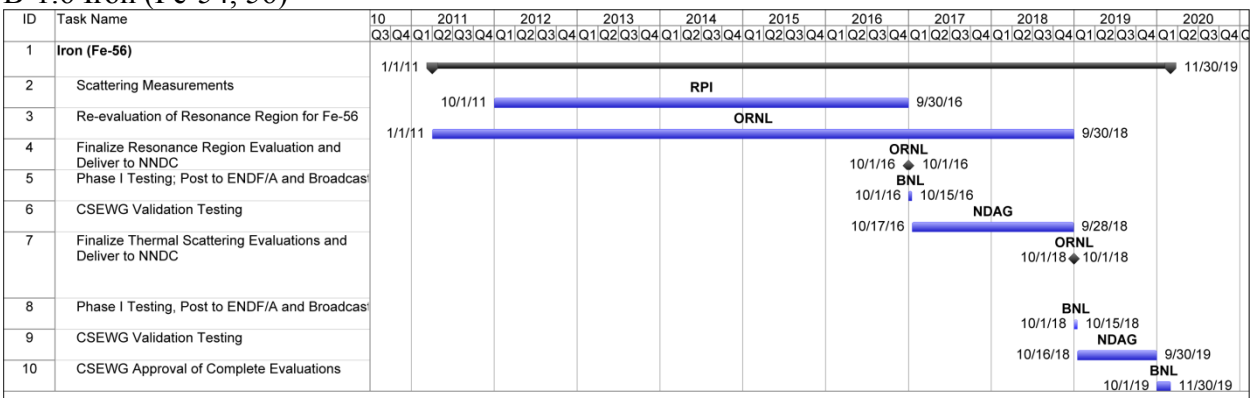
B-1.4 Dysprosium (Dy-161, 162, 163, 164)



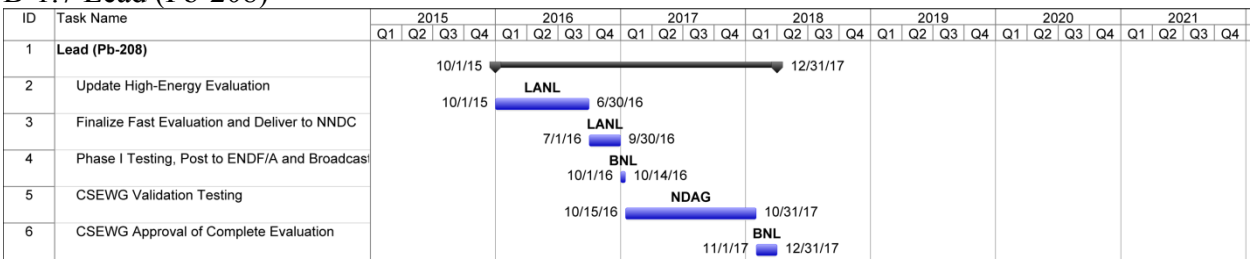
B-1.5 Gadolinium (Gd-155, 156, 157, 158, 160)



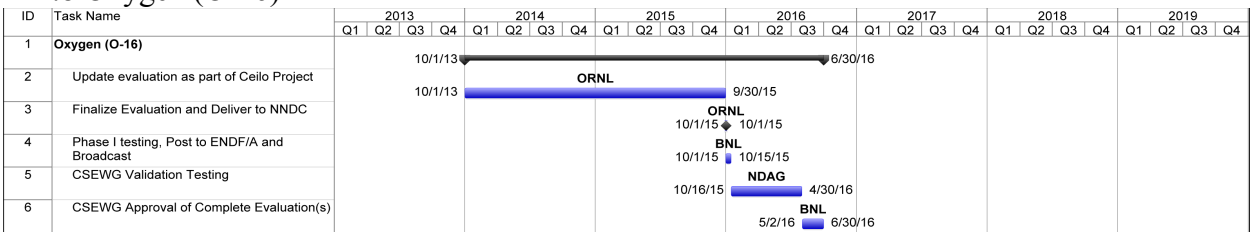
B-1.6 Iron (Fe-54, 56)



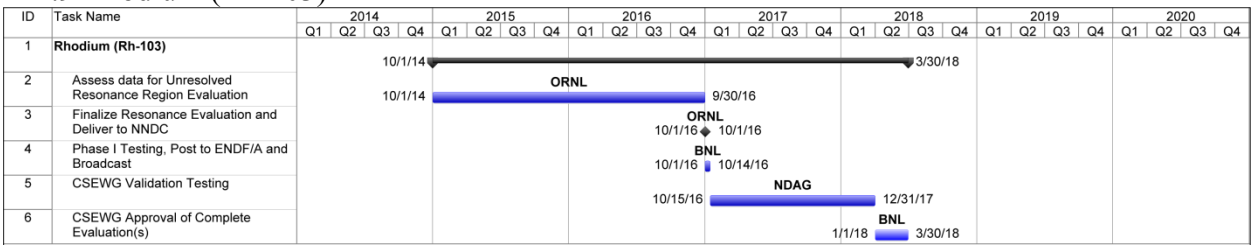
B-1.7 Lead (Pb-208)



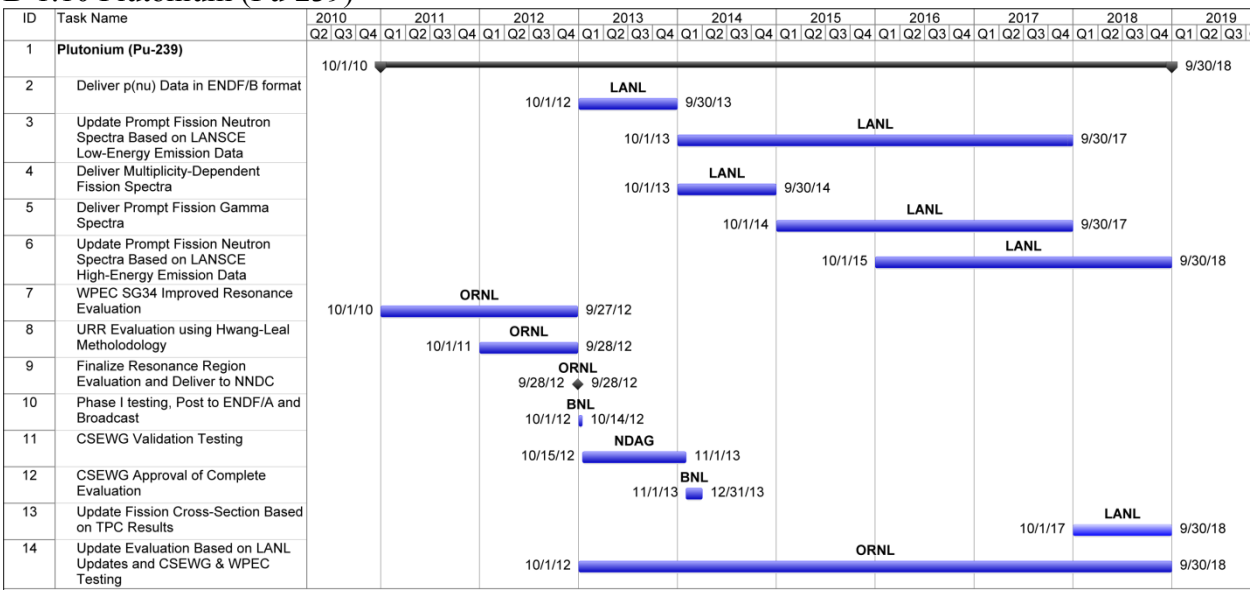
B-1.8 Oxygen (O-16)



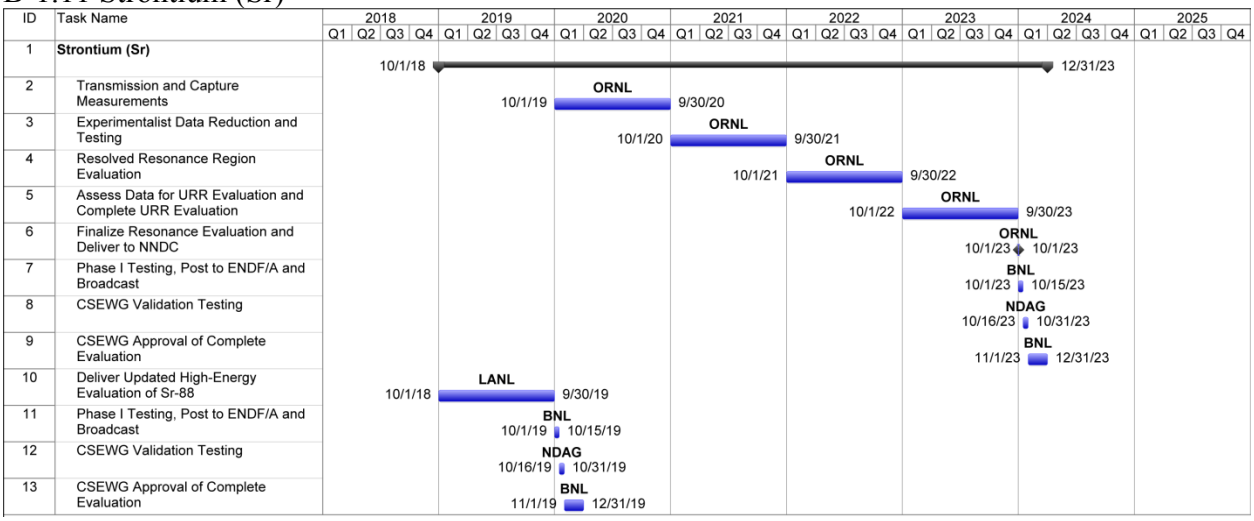
B-1.9 Rhodium (Rh-103)



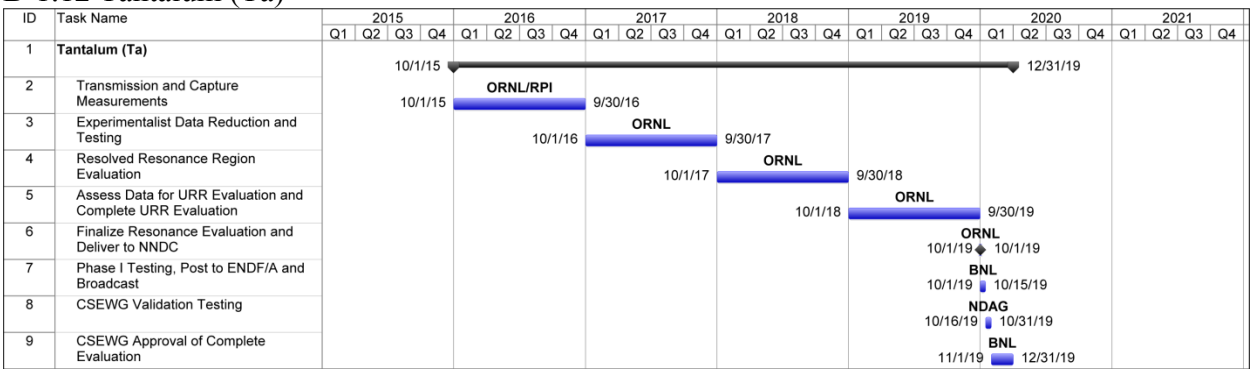
B-1.10 Plutonium (Pu-239)



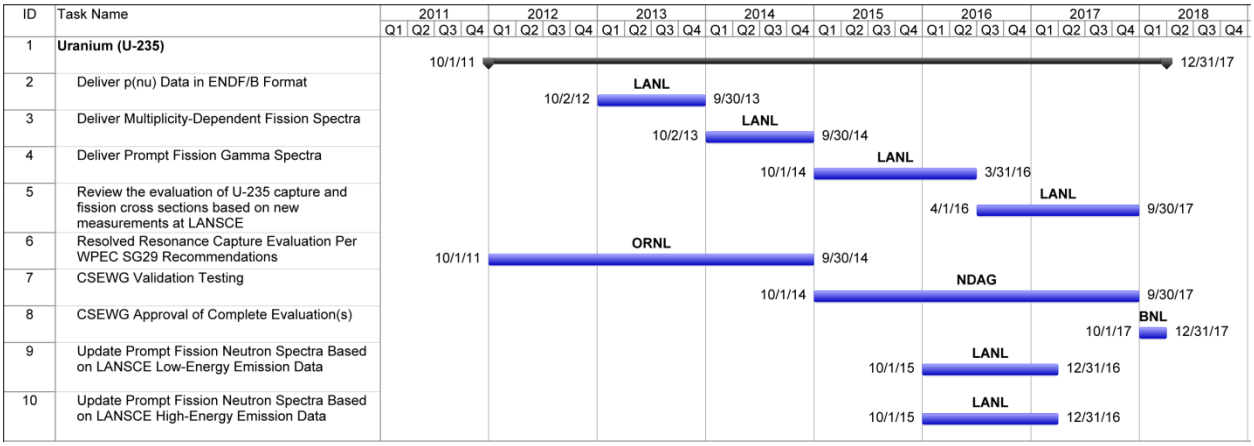
B-1.11 Strontium (Sr)



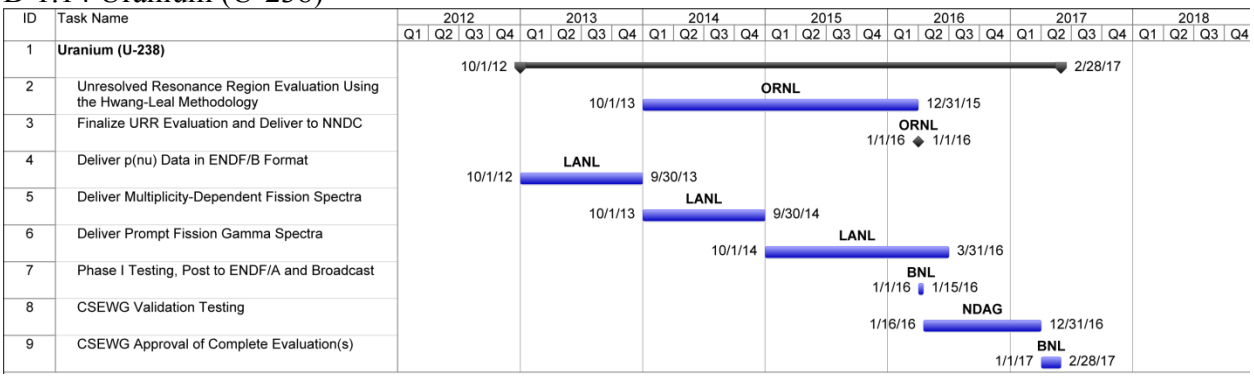
B-1.12 Tantalum (Ta)



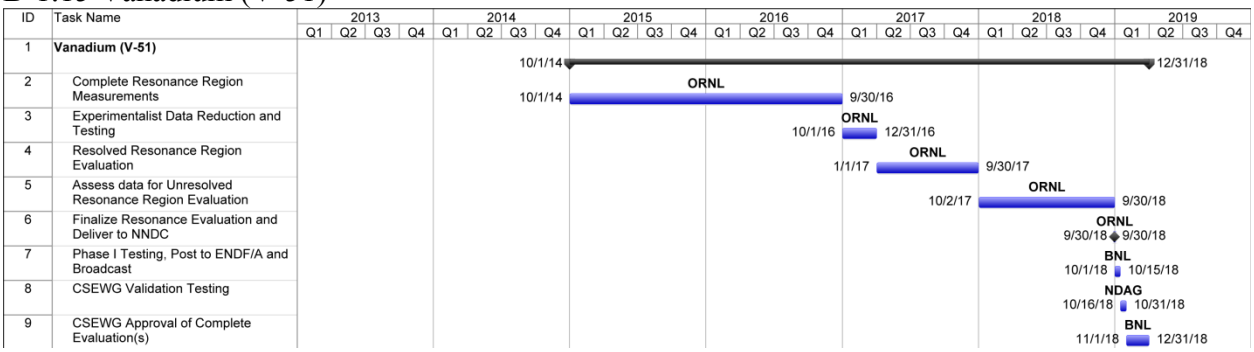
B-1.13 Uranium (U-235)



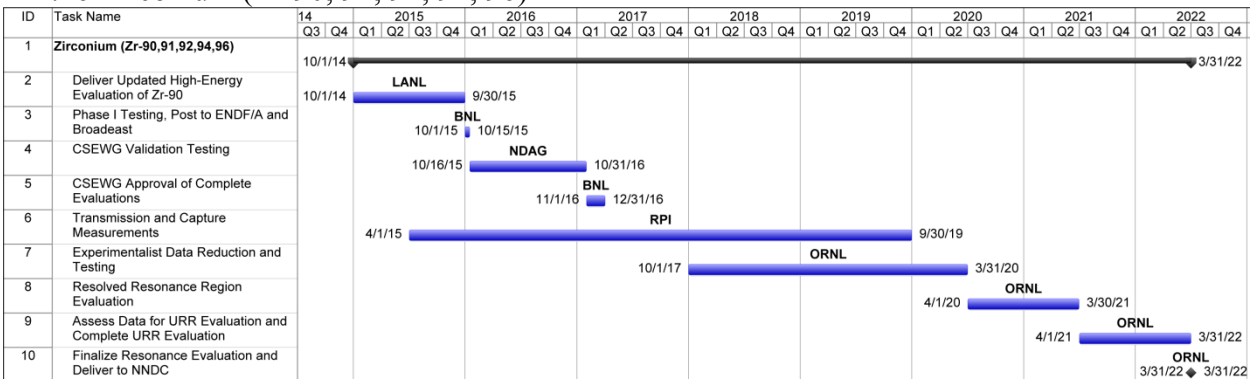
B-1.14 Uranium (U-238)



B-1.15 Vanadium (V-51)



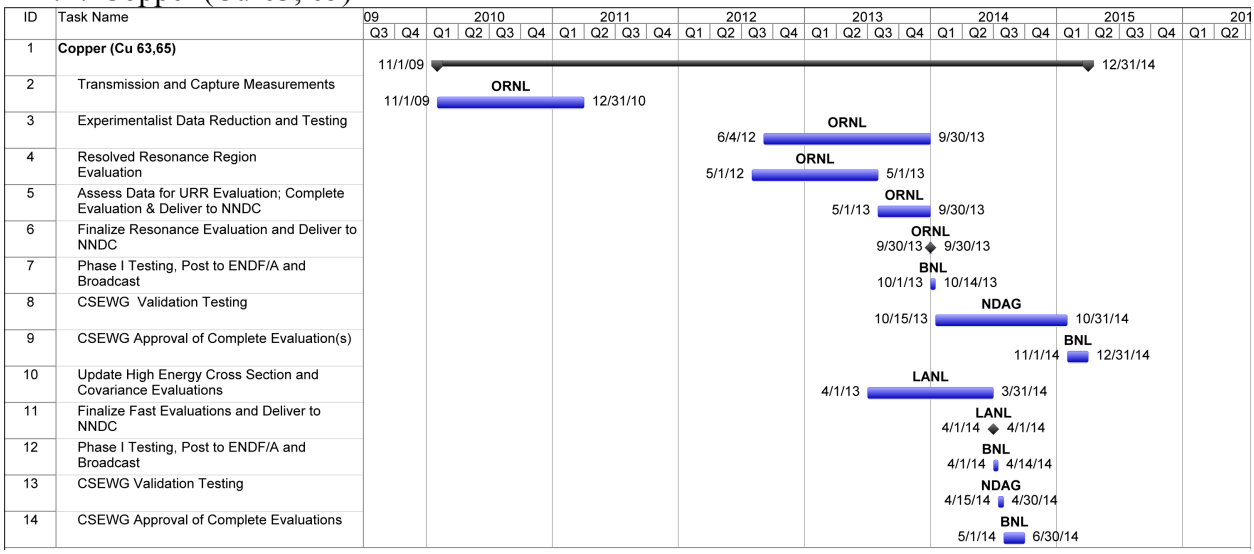
B-1.16 Zirconium (Zr-90, 91, 92, 94, 96)



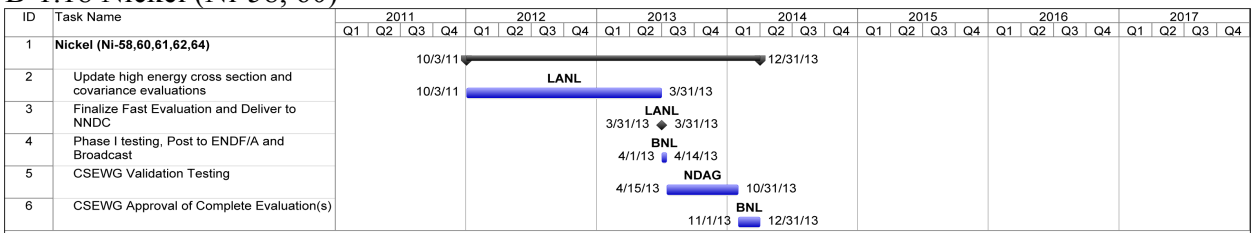
Completed Differential Measurements and Evaluations – Elements

(Evaluations have been submitted to NNDC and are candidates for the next ENDF release. Testing will be performed as part of ENDF release effort, and additional revisions may be requested by NNDC before evaluations are formally released. The GANTT charts are retained in the Five Year Plan pending release of the new evaluations by NNDC.)

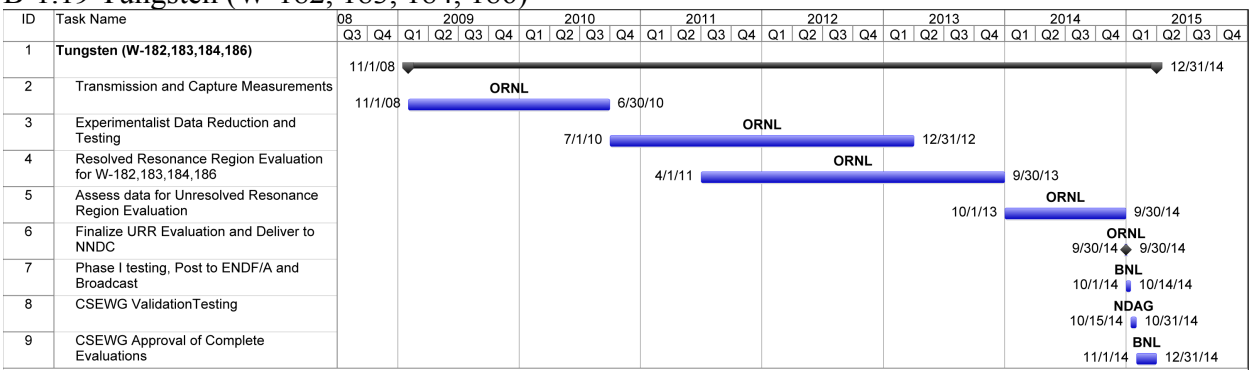
B-1.17 Copper (Cu-63, 65)



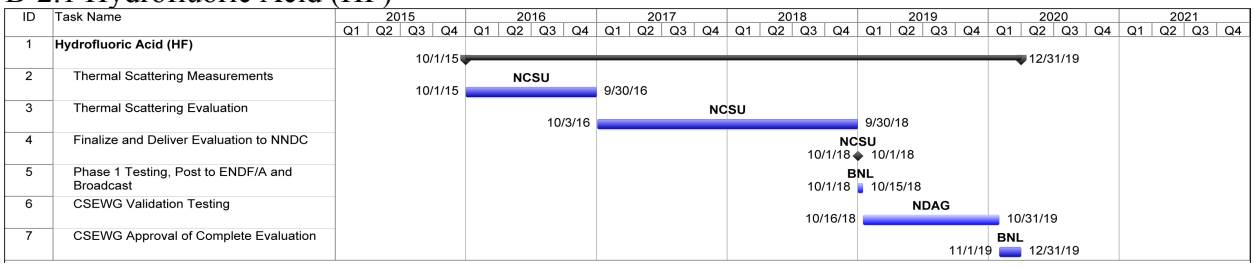
B-1.18 Nickel (Ni-58, 60)



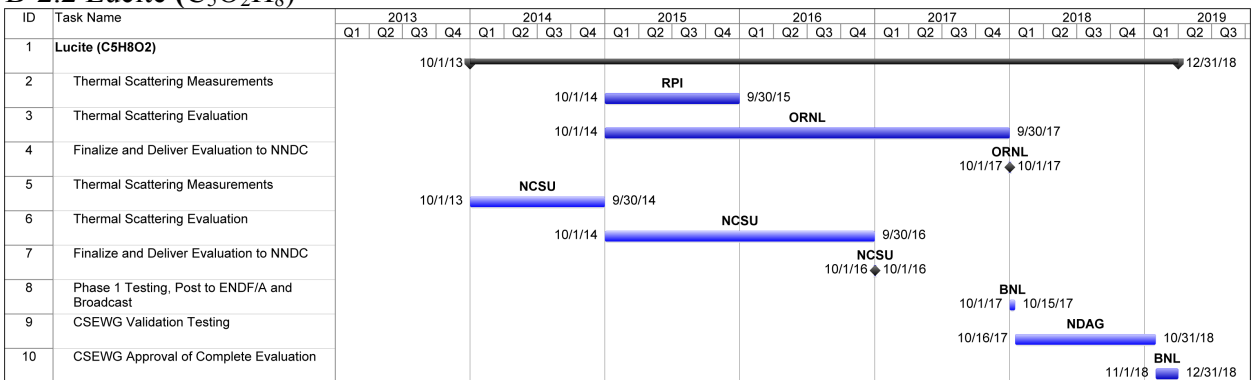
B-1.19 Tungsten (W-182, 183, 184, 186)



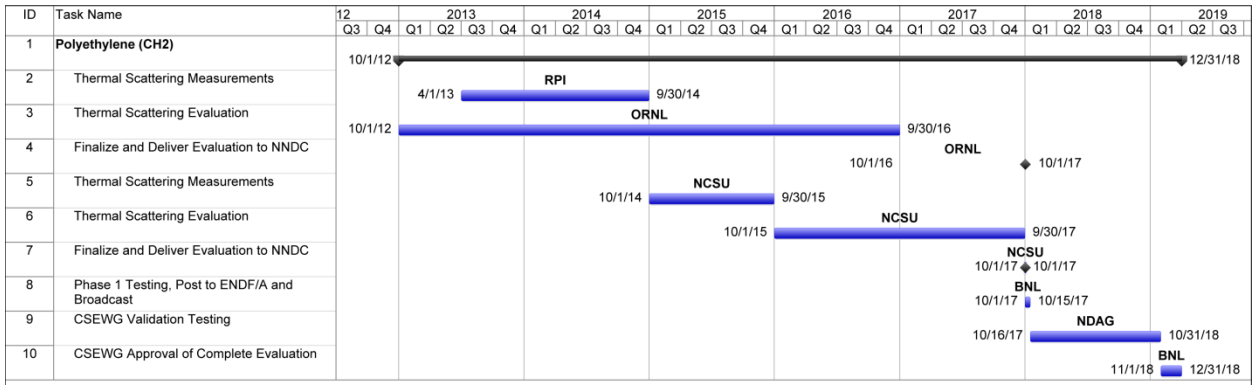
B-2.1 Hydrofluoric Acid (HF)



B-2.2 Lucite ($C_5O_2H_8$)



B-2.3 Polyethylene (CH_2)



Appendix C

Fiscal Year 2016 Projected Foreign Travel

Destination	Date	Labs	Count	Costs ($)	One Sentence Description	Task	Milestone	Justification
OECD/NEA Paris, France	Apr-16	LANL LLNL ORNL SNL	9	45,000	Present/publish NCSP ICSBEP evaluations at annual ICSBEP Technical Meeting (Favorite, Harms + 1, Heinrichs, Hutchinson, Keefer, Kim, Miller, Sanchez)	LLNL-IPD1	Provide brief trip summary report to NCSP Manager (Q3).	Present/publish NCSP ICSBEP evaluations at annual ICSBEP Technical Meeting.
AWE Aldermaston, UK	May-16	LLNL	3	15,000	Coordinate International Collaboration Efforts (Heinrichs, Hickman, McAvoy)	LLNL-all	Provide brief trip summary report to NCSP Manager (Q3).	Allows LLNL to discuss International Collaboration efforts that must be done in person (i.e., determining material or equipment that needs transporting, etc.).
OECD/NEA Paris, France	Sep-16	LLNL	2	10,000	Participate in WPNCS annual meeting (Verbeke, Scorby)	LLNL-AM1	Provide brief trip summary report to NCSP Manager (Q4).	Participate in WPNCS governance and expert group meetings on MC methods and excursion analyses.
Bruges, Belgium	Sep-16	LLNL NCSU	2	10,000	Participate in ND2016 bi-annual meeting (Hawari, Heinrichs)	LLNL-ND1	Provide brief trip summary report to NCSP Manager (Q4).	Present/publish results of LLNL-ND1 new thermal scattering laws.
Poole, UK	May-16	LLNL	2	10,000	ANSWERS Seminar (Lee, Percher)	LLNL-AM1	Provide brief trip summary report to NCSP Manager (Q3).	Attend the AMEC 2015 ANSWERS Seminar devoted to radiation shielding, reactor physics and nuclear criticality safety software applications, V&V and R&D.
OECD/NEA Paris, France	May-16	RPI	1	5,000	Participate in WPEC annual meeting (Danon, Liu)	RPI-ND1	Provide brief trip summary report to NCSP Manager (Q3).	As US Measurements Chair, participate in WPEC annual meeting to present NCSP/RPI nuclear data measurement work (Danon).
Bruges, Belgium	Sep-16	RPI	1	5,000	Participate in ND2016 bi-annual meeting (Danon)	RPI-ND2	Provide brief trip summary report to NCSP Manager (Q4).	Participate in the WINS nuclear scattering workshop to present NCSP/RPI thermal scattering work to address thermal moderator data needs for criticality safety applications.
Bruges, Belgium	Sep-16	LANL	3	12,000	Participate in ND2016 bi-annual meeting (Talou, Hale, White)	LANL-ND1	Provide brief trip summary report to NCSP Manager (Q4).	Present/publish results of LANL-ND1 work performed in 2015.
AWE Aldermaston, UK	May-16	LANL	1	5,000	Coordinate International Collaboration Efforts (Jesson)	LANL-IE3	Provide brief trip summary report to NCSP Manager (Q3).	Allows LANL to discuss International Collaboration efforts that must be done in person (i.e., determining material or equipment that needs transporting, etc.).

Destination	Date	Labs	Count	Costs ($)	One Sentence Description	Task	Milestone	Justification
OECD/NEA Paris, France	May-16	LANL	3	12,000	Participate in WPEC annual meeting (Kahler, Conlin, White)	LANL-AM2, LANL-ND1	Provide brief trip summary report to NCSP Manager (Q3).	Will include emphasis on CIELO Project and GND Project. CIELO related work includes international evaluation of important isotopes and criticality data testing of new cross sections that will subsequently appear in a next generation ENDF library. GND related work ensures that the needs of NCSP are met by the new nuclear data format and relates to the next generation NJOY code, NJOY21.
Paris, France	May-16	LANL	2	6,000	Participate in annual OECD/NEA Working Party on Nuclear Criticality Safety and various Expert Groups (Brown, Rising)	LANL-AM1	Provide brief trip summary report to NCSP Manager (Q3).	NCSP Monte Carlo people from LANL & ORNL traditionally participate in these meetings. Benefits V&V, methods, data, etc. Forrest specifically is the founder & participant in the Expert Group for Advanced Monte Carlo Techniques.
Vienna, Austria	TBD	LANL	1	0	IAEA Coordinated Research Project meetings on Radiation Damage and Testing/Validating a new Dosimetry Cross Section Library (Kahler OR Conlin)	LANL-AM2, LANL-ND1	Provide brief trip summary report to NCSP Manager (Q4).	(Cost is salary only as the IAEA typically pays participant transportation, lodging and per diem expenses) The Radiation Damage CRP is expected to yield improved/updated NJOY processing methods. The CRP focused on Dosimetry Cross Section Library is expected to yield updated data for selected ENDF/B evaluations.
IRSN Paris, France	TBD	LANL	2	10,000	MCNP Criticality safety Class at IRSN (Brown, Bull)	LANL-AM1	Provide brief trip summary report to NCSP Manager (Q4).	Has been discussed previously, but never funded and finalized. Such a class would benefit both LANL and IRSN.
IRMM Mol, Belgium	TBD – 3 trips	ORNL	1	45,000	Perform resonance region nuclear data measurements using GELINA facility at IRMM in accordance with Appendix B of the Five-Year Plan (Guber)	ORNL-ND1	Provide brief trip summary report to NCSP Manager (Q4).	Continues cross-section measurements and the production of new cross-section evaluations with covariance data for U.S.
India	Jun-16	ORNL	1	5,000	Participate in ISO Standards meeting (Bowen).	NCSP-TS7	Provide brief trip summary report to NCSP Manager (Q4).	Participate in ISO Standards meeting (ISO TC85/SC5/WG8) on nuclear criticality safety to ensure US NCSP interests are represented in the international standards development and as succession planning for replacement of Hopper participation (Bowen).
IRSN Paris, France	TBD – 3 trips	ORNL	1	45,000	Perform nuclear data evaluation and testing work with IRSN (Pigni, Sobes)	ORNL-ND1	Provide brief trip summary report to NCSP Manager (Q4).	Continues cross-section evaluation and testing work with IRSN to provide new cross-section evaluations with covariance data for U.S.

Destination	Date	Labs	Count	Costs ($)	One Sentence Description	Task	Milestone	Justification
OECD/NEA Paris, France	May-16	ORNL	1	5,000	Participate in WPEC annual meeting as Chair of ENDF Formats Committee, coordinate international nuclear data collaborations for the NCSP, and present NCSP/ORNL nuclear data evaluation work (Dunn)	ORNL-ND1	Provide brief trip summary report to NCSP Manager (Q3).	Exchange of information with international nuclear data community to improve NCSP nuclear data evaluations and cultivate new collaborations to support future NCSP nuclear data evaluation work tasks. Also, includes Interim NDAG Chair participation in WPEC meeting.
OECD/NEA Paris, France	May-16	ORNL	1	5,000	Participate in WPNCS (Rearden)	ORNL-AM2	Provide brief trip summary report to NCSP Manager (Q3).	Continues NCSP leadership in S/U analysis methods and fosters continued collaboration with international partners to test and improve NCSP S/U analysis capabilities for supporting criticality safety applications.
Bruges, Belgium	Sep-16	ORNL	1	5,000	Participate in ND2016 meeting (Dunn)	ORNL-ND1	Provide brief trip summary report to NCSP Manager (Q4).	Present/publish results of ORNL-ND1 work performed in 2015.
Vienna, Austria	Oct-15	ORNL	1	5,000	IAEA Coordinated Research Project meetings on Radiation Damage and Testing/Validating a new Dosimetry Cross Section Library (Doro)	ORNL-ND1	Provide brief trip summary report to NCSP Manager (Q4).	The Radiation Damage CRP is expected to yield improved/updated AMPX processing methods. The CRP focused on Dosimetry Cross Section Library is expected to yield updated data for selected ENDF/B evaluations.
Aix-en-Provence France	Oct-15	ORNL	1	5,000	WONDER ND Scattering Meeting (Goran)	ORNL-ND1	Provide brief trip summary report to NCSP Manager (Q4).	Report on thermal scattering evaluation capability development under ORNL-ND4

FYI - NOTE: The above projected foreign travel meetings have been confirmed as technical working group meetings and not as conferences.

Appendix D

Baseline Budget Needs for Execution Year FY2016

Baseline budget need for the FY2016 Nuclear Criticality Safety Program (NCSP) is $23,785k with 95% of funding supporting NCSP FTE's, equating to approximately 49 national laboratory or facility contractor employees, who provide programmatic needs as outlined in the NCSP *The Mission and Vision of the United States Department of Energy Nuclear Criticality Safety Program for the Fiscal Years 2014-2023.* All tasks are approved based on their contribution to the achievement of the five- and ten-year goals as outlined in the Mission and Vision document.

NCSP includes the following five technical program elements plus support infrastructure, with each having the major deliverables for FY2016:

- Analytical Methods
  - Criticality Safety Computer Codes SCALE and MCNP support. Maintain Radiation Safety Information Computational Center who distributes all software. Perform sensitivity/uncertainty analysis for CAAS experiments and designs. ~8 FTEs supported. International collaborations: SCALE, NJOY, MCNP, AMPX work with AWE and IRSN.
- Information Preservation and Dissemination
  - NCSP website maintenance. ~8 new ICSBEP evaluations and publications (OECD collaboration).
- Integral Experiments
  - Execution of ~20 critical/subcritical experiments and 10 critical/subcritical experiment evaluations published (NCERC and SNL). Permanent party staff supported. DSA changes. Control System upgrades needed. International collaborations: TEX experiments with IRSN and AWE, SILENE publication with IRSN/CEA, CAAS experiment design with AWE, IRSN, Japan, SNL experiment design and execution with IRSN.
  - Continue deliverables in WFO agreements with NASA. NASA Space Technology Mission Directorate (STMD) has a firm program deliverable to complete KRUSTY in 2017 in collaboration with the NCSP. The KRUSTY core is of enduring interest for future experiments supporting NNSA mission and thus we are sharing costs.
- Nuclear Data
  - Nuclear data evaluations and measurements of ~19 elements and ~3 compounds. RPI refurbishment (NR collaboration). Produce new scattering law data (NCSU and RPI collaboration). ~7 FTEs supported. International collaborations: Data testing and evaluations with AWE and IRSN. Measurements with IRMM.
  - Training and Education
  - Two 2-week courses at NNSS/NCERC/Sandia.
  - One 1-week managers course at Sandia.
  - One 1-week managers course at NCERC.
  - One "special" week-long course similar to a Sandia or NCERC hands-on class.
- NCSP Technical Support: CSSG. NDAG. Succession Planning for key areas of NCSP expertise. ORNL management support. ~3 FTEs supported.

Over target budget need for FY2016 NCSP is $1,790K that would support 12 additional high priority tasks to address key Mission and Vision goals not addressed within the current budget target:

- MCNP modernization needed to support operation on advanced computing platforms ($50K)
- Develop and deploy time-dependent multi-physics capabilities for excursion analyses ($100K)
- Develop and deploy time-dependent geometry modeling capabilities ($150K)
- Couple modern NCS radiation transport tools with CAD/CAE packages ($150K)
- Modernize SAMMY resonance analysis software needed for nuclear data evaluations ($250K)
- Develop and utilize sensitivity/uncertainty analysis tools to prioritize and quantify nuclear data measurement and evaluation needs ($100K)
- Design and deploy radiochemistry laboratory at NNSS ($100K)
- Standup "hot"/"cold" machine shops at NCERC ($100K)
- Design and deploy low scatter capabilities at NCERC ($200K)
- Develop and deploy a mobile (CAT III or IV) critical/near critical hands-on demo capability ($100K)
- Develop tutorial on subcritical methods and benchmark interpretation for NCS users ($90K)
- Start working off the backlog of approximately 200 integral experiments ($400K)

Baseline Budget Needs for Execution Year FY2017

Baseline budget need for the FY2017 Nuclear Criticality Safety Program (NCSP) is $27,298k with 95% of funding supporting NCSP FTE's, equating to approximately 50 national laboratory or facility contractor employees, who provide programmatic needs as outlined in the NCSP *The Mission and Vision of the United States Department of Energy Nuclear Criticality Safety Program for the Fiscal Years 2014-2023.* All tasks are approved based on their contribution to the achievement of the five- and ten-year goals as outlined in the Mission and Vision document.

NCSP includes the following five technical program elements plus support infrastructure, with each having the major deliverables for FY2017:

- Analytical Methods
  - Criticality Safety Computer Codes SCALE and MCNP support. Maintain Radiation Safety Information Computational Center who distributes all software. Perform sensitivity/uncertainty analysis for CAAS experiments and designs. ~8 FTEs supported. International collaborations: SCALE, NJOY, MCNP, AMPX work with AWE and IRSN.
- Information Preservation and Dissemination
  - NCSP website upgrade and maintenance. ~8 new ICSBEP evaluations and publications (OECD collaboration). Provide experimental uncertainty correlations.
- Integral Experiments
  - Execution of ~17 critical/subcritical experiment and 10 critical/subcritical experiment evaluations published (NCERC and SNL). Permanent party staff supported. Control System upgrades needed. International collaborations: TEX experiments with IRSN and AWE, NDA experiments with IRSN/CEA, CAAS experiment design with AWE, IRSN, Japan, SNL experiment design and execution with IRSN.
  - Continue deliverables in WFO agreements with NASA. NASA Space Technology Mission Directorate (STMD) has a firm program deliverable to complete KRUSTY in 2017 in collaboration with the NCSP. The KRUSTY core is of enduring interest for future experiments supporting NNSA mission and thus we are sharing costs.
  - Additional funding requirement to fund both Laboratory logistics costs and NNSS safety basis work.
- Nuclear Data
  - Nuclear data evaluations and measurements of ~20 elements and ~3 compounds. RPI refurbishment (NR collaboration). Produce new scattering law data (NCSU and RPI collaboration). ~7 FTEs supported. International collaborations: Data testing and evaluations with AWE and IRSN. Measurements with IRMM.
- Training and Education
  - Three 2-week courses at NNSS/NCERC/Sandia.
  - One 1-week managers course at Sandia.
  - One 1-week managers course at NCERC.
  - One "special" week-long course similar to a Sandia or NCERC hands-on class.
- NCSP Technical Support: CSSG. NDAG. Succession Planning for key areas of NCSP expertise. ORNL management support. ~3 FTEs supported.

Over target budget need for FY2017 NCSP is $1,125K that would support 8 additional high priority tasks to address key Mission and Vision goals not addressed within the current budget target:

- MCNP modernization needed to support operation on advanced computing platforms ($75K)
- Develop and deploy time-dependent multi-physics capabilities for excursion analyses ($100K)
- Develop and deploy time-dependent geometry modeling capabilities ($300K)
- Modernize SAMMY resonance analysis software needed for nuclear data evaluations ($200K)
- Develop and utilize S/U analysis tools to prioritize and quantify nuclear data measurement/evaluation needs ($100K)
- Design and deploy radiochemistry laboratory at NNSS ($100K)
- Standup "hot"/"cold" machine shops at NCERC ($100K)
- Design and deploy low scatter capabilities at NCERC ($150K)

Baseline Budget Needs for Execution Year FY2018

Baseline budget need for the FY2018 Nuclear Criticality Safety Program (NCSP) is $26,086k with 95% of funding supporting NCSP FTE's, equating to approximately 47 national laboratory or facility contractor employees, who provide programmatic needs as outlined in the NCSP *The Mission and Vision of the United States Department of Energy Nuclear Criticality Safety Program for the Fiscal Years 2014-2023.* All tasks are approved based on their contribution to the achievement of the five- and ten-year goals as outlined in the Mission and Vision document.

NCSP includes the following five technical program elements plus support infrastructure, with each having the major deliverables for FY2018:

- Analytical Methods
  - Criticality Safety Computer Codes SCALE and MCNP support. Maintain Radiation Safety Information Computational Center who distributes all software. ~8 FTEs supported. International collaborations: SCALE, NJOY, MCNP, AMPX work with AWE and IRSN.
- Information Preservation and Dissemination
  - NCSP website upgrade and maintenance. ~9 new ICSBEP evaluations and publications (OECD collaboration). Provide experimental uncertainty correlations.
- Integral Experiments
  - Execution of ~18 critical/subcritical experiment and 9 critical/subcritical experiment evaluations published (NCERC and SNL). Permanent party staff supported. DSA changes and facility modifications for pneumatic rabbit system and NAD lab construction. International collaborations: TEX experiments with IRSN and AWE, SILENE publication with IRSN/CEA, CAAS experiment design with AWE, IRSN, Japan, SNL experiment design and execution with IRSN.
- Nuclear Data
  - Nuclear data evaluations and measurements of ~20 elements and ~3 compounds. RPI refurbishment (NR collaboration). Produce new scattering law data (NCSU and RPI collaboration). ~7 FTEs supported. International collaborations: Data testing and evaluations with AWE and IRSN. Measurements with IRMM.
- Training and Education
  - Three 2-week courses at NNSS/NCERC/Sandia.
  - One 1-week managers course at Sandia.
  - One 1-week managers course at NCERC.
  - One "special" week-long course similar to a Sandia or NCERC hands-on class for AWE.
- NCSP Technical Support: CSSG. NDAG. Succession Planning for key areas of NCSP expertise. ORNL management support. ~3 FTEs supported.

Over target budget need for FY2018 NCSP is $1,500K that would support 8 additional high priority tasks to address key Mission and Vision goals not addressed within the current budget target:

- MCNP modernization needed to support operation on advanced computing platforms ($250K)
- SCALE modernization needed to support operation on advanced computing platforms ($250K)
- Develop and deploy time-dependent multi-physics capabilities for excursion analyses ($100K)
- Modernize SAMMY resonance analysis software needed for nuclear data evaluations ($250K)
- Develop and utilize sensitivity/uncertainty analysis tools to prioritize and quantify nuclear data measurement and evaluation needs ($100K)
- Design and deploy radiochemistry laboratory at NNSS ($100K)
- Standup "hot"/"cold" machine shops at NCERC ($100K)
- Continue working off the backlog of approximately 200 integral experiments ($350K)

Appendix E

International Collaboration with the Institut De Radioprotection et De Sûreté Nucléaire (IRSN)

REFERENCE			IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2016 IRSN contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
Analytical Methods						
IRSN-AM1	Validation methods	ORNL-IE1	Identification of a selection of Integral Experiments to be analyzed for covariance matrix development	E. IVANOV	M. DUNN B. REARDEN	ORNL
IRSN-AM3	Monte Carlo & sensitivity calculations	ORNL-AM2	Comparison and testing of the methods that are implemented in Monte Carlo codes - IRSN personnel training	A. JINAPHANH	M. DUNN B. REARDEN	ORNL
IRSN-AM5	Update of the slide rules	ORNL-AM6 LLNL-AM3	IRSN proposal: Update of the “slide rules” for the rapid response estimation of a criticality accident	M. DULUC	M. DUNN D. HEINRICHS	ORNL LLNL
IRSN-AM7	Modernization of cross-sections processing tool	LANL-AM2	Contribution on OECD SG38 group forward a new format for nuclear data suitable for LANL and IRSN tools	W. HAECK	J. CONLIN	LANL
IRSN-AM8	Improvement of analytical methods for criticality safety	NCSP expert group (leader : M. Dunn)	IRSN participation to NCSP AM expert group	E. LETANG	M. DUNN	NCSP
IRSN-AM9	Cross-sections processing validation	ORNL-AM3	First step of the development of an interface between GAIA and AMPX	R. ICHOU	M. DUNN	ORNL
IRSN-AM11	Computation methods for optimization of integral experiment design and studies (criticality, slides rules,…) with COG	LLNL-AM1	Installation of PROMETHEE and training and assistance on PROMETHEE use (parameterized input decks,…) Development of a COG plugin for PROMETHEE	G. CAPLIN	D. HEINRICHS	LLNL
IRSN-AM12	Monte Carlo & sensitivity calculations	LANL-AM1	LANL/IRSN Collaboration Proposal on Monte Carlo codes Action plan for the next years	I. DUHAMEL	F. BROWN	LANL

REFERENCE			IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2016 IRSN contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
Integral Experiments						
IRSN-IE1	TEX/Pu/Ta experiments	LLNL-IE	Sensitivity/uncertainty analysis of the designed configurations to provide feedback from the future experiments to ND	M. BROVCHENKO	D. HEINRICHS C. PERCHER	LLNL
IRSN-IE5	Restart BUCCX experiments	SNL-IE1	Contribution to the evaluation and the analyses of LCT079 with uncertainties reduction thanks to rods measurements and reproducibility, if experiments available	N. LECLAIRE	G. HARMS	SNL
IRSN-IE6	Rh foils experiments	SNL-IE1	Design proposal, contribution to CED 1 report	N. LECLAIRE	G. HARMS	SNL
IRSN-IE7	Mo foils experiments	SNL-IE1	Design optimization, contribution to CED reports - Additional Mo foils supplying in 2016 if the IER is accepted	I. DUHAMEL	G. HARMS	SNL
IRSN-IE8	Ti experiments	SNL-IE1	Contribution to CED reports, ICSBEP evaluation and analyses of experiments	I. DUHAMEL	G. HARMS	SNL
IRSN-IE11	TEX/U/Hf experiments	LLNL-IE1	Calculational support for sensitivity/uncertainties analyses of the designed configurations to provide feedback from the future experiments to ND - Characterization of Jemima plates	M. BROVCHENKO	D. HEINRICHS C. PERCHER M. ZERKLE	LLNL
IRSN-IE12	GODIVA	LLNL-IE1	Analysis of results	M. DULUC	D. HEINRICHS	LLNL
IRSN-IE13		LLNL-IE1	Participate in the design, provide IRSN materials for irradiation	M. DULUC	D. HEINRICHS	LLNL
IRSN-IE14	FLATTOP	LLNL-IE1	Participate in the design, provide IRSN materials for irradiation	M. DULUC	D. HEINRICHS	LLNL
IRSN-IE15		LLNL-IE1	Participate in the design	M. DULUC	D. HEINRICHS	LLNL
IRSN-IE16	Subcritical ("noise") measurements	LANL-IE3	LANL/IRSN Collaboration - Proposal on neutron noise measurement	G. CAPLIN	J. HUTCHINSON	LANL

REFERENCE			IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2016 IRSN contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
IRSN-IE21	Multiplicity benchmark on ISSA	LLNL-IE12	Design Benchmark, Attend measurements, Evaluation of results	G. CAPLIN	D. HEINRICHS	LLNL
IRSN-IE25	TEX - MOX	LLNL-IE1	IRSN leads the design of the experiments: design proposal for TEX configuration with U and Pu plates - contribution to CED reports - estimation of experimental uncertainties, sensitivity/uncertainty studies	I. DUHAMEL	D. HEINRICHS C. PERCHER	LLNL
IRSN-IE26	TEX - Iron	LLNL-IE1	Contribution to the design proposal for TEX configuration with Iron plates - contribution to CED report Sensitivity/uncertainty analysis of the designed configurations to provide feedback from the future experiments to ND	I. DUHAMEL	D. HEINRICHS C. PERCHER	LLNL
IRSN-IE27	GODIVA CAAS benchmark	ORNL-IE4	Participate in the design, provide IRSN materials for irradiation	M. DULUC	M. DUNN T. MILLER D. HEINRICHS	ORNL LLNL
IRSN-IE28	Cf-252 CAAS benchmark	LLNL-IE1	Participate in the design, provide IRSN materials for irradiation	M. DULUC	D. HEINRICHS	LLNL
IRSN-IE29	Correction factor for dosimetry linked to the orientation of the victim	LLNL-IE1	Participate in the design	M. DULUC	D. HEINRICHS	LLNL
IRSN-IE30	Full dosimetry exercise around GODIVA/FLATTOP reactors	LLNL-IE1	Participate in the design	M. DULUC	D. HEINRICHS	LLNL
IRSN-IE32	Development of subcritical measurement protocol for use with research reactors	LANL-IE3	Feasibility study – Technical exchanges	G. CAPLIN	J. HUTCHINSON	LANL
Information Preservation and Dissemination						
IRSN-IPD3	SILENE CAAS benchmark	ORNL-IE2	External review of the evaluation (Phase 2 and 3)	M. DULUC	M. DUNN T. MILLER	ORNL
IRSN-IPD4	External review of neutron noise measurement benchmarks (cf. IRSN-IE16)	LANL-IE3	Review of BeRP-Balls W benchmark	G. CAPLIN	J. HUTCHINSON	LANL
Nuclear Data						
IRSN-ND1	Nuclear data evaluation	ORNL-ND1	Contribution to new evaluation and validation	L. LEAL	M. DUNN	ORNL

REFERENCE			IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2016 IRSN contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
IRSN-ND2	Nuclear data / processing validation	LANL-ND1	Cross testing of new evaluation	L. LEAL	S. KAHLER	LANL
IRSN-ND3	Nuclear data / processing validation	LLNL-AM1	Cross testing of new evaluation processing	L. LEAL	D. HEINRICHS	LLNL
Training and education						
IRSN-T&E1	Criticality Safety Class at NCERC	LANL-T&E1 LLNL-T&E1	IRSN attendance to NCSP classes Possible lectures by IRSN	G. CAPLIN	J. HUTCHINSON	LANL
IRSN-T&E3	Comparison of NCS assessment methods	-	Proposition for a new FY2017 work: explain French way of assessing NCS, Contribution to a common report	G. CAPLIN	-	LLNL LANL ORNL
IRSN-T&E4	Comparison of NCS assessment methods	LANL-T&E1	IRSN attendance to a dedicated training on MCNP for different uses of the code	I. DUHAMEL	F. BROWN	LANL

Appendix F

International Collaboration with the Atomic Weapons Establishment (AWE)

AWE has an active and growing program of collaboration with the NCSP that aims to underpin and enhance AWE's nuclear criticality safety and associated technologies. AWE will provide its expertise and capabilities to support the NCSP's mission and vision so that the collaboration is mutually beneficial to both organizations.

REFERENCE			AWE Contribution and POCs			
AWE Reference	**Task Title**	**NCSP Reference**	**AWE Contribution**	**AWE Technical POC**	**NCSP Technical POC**	**DOE Lab**
Analytical Methods						
AWE-AM1	Update of the criticality slide rule for rapid response estimation of the consequences of a criticality accident	ORNL-AM6 LLNL-AM3	Provide calculation support to international collaboration	R. Jones C. Wilson	M. Dunn D. Heinrichs	ORNL LLNL
AWE-AM2	Multi-physics Methods for Simulation of Critical Excursions	LLNL-AM2	Provide peer review. Provide measurement capabilities to support data needs, eg. time-dependent leakage spectrum	C. Wilson	D. Heinrichs	LLNL
Integral Experiments						
AWE-IE1	International Inter-comparison of Nuclear Accident Dosimetry using Godiva-IV	LLNL-IE1	Participate in design of experiment. Participate in inter-comparison with UK accident dosimetry.	C. Wilson L. Buchanan	D. Heinrichs	LLNL
AWE-IE2	Characterization of leakage spectrum from the Flat-top critical assembly machine	LLNL-IE1 LLNL-IE6	Participate in design and analysis. Provide neutron spectrometry capability.	L. Clark C. Wilson	D. Heinrichs	LLNL
AWE-IE3	International Inter-comparison of Nuclear Accident Dosimetry using Flat-top	LLNL-IE1	Participate in design and analysis. Participate in inter-comparison with UK accident dosimetry	C. Wilson L. Buchanan	D. Heinrichs	LLNL

REFERENCE			AWE Contribution and POCs			
AWE Reference	Task Title	NCSP Reference	AWE Contribution	AWE Technical POC	NCSP Technical POC	DOE Lab
AWE-IE4	Develop New Techniques for Nuclear Accident Dosimetry	LLNL-IE1	Investigate new techniques and technologies, including biological dosimetry. Participate in experimental studies. Provide data to international collaborators.	C. Wilson L. Buchanan	D. Heinrichs	LLNL
AWE-IE5	Sub-critical neutron multiplication measurements	LANL-IE3 LLNL-IE1	Participate in a range of experiments. Provide measurement data and analyses to support benchmark evaluations	N. McMillan N. Kelsall	J. Hutchinson S. Walston	LANL LLNL
AWE-IE6	Godiva-IV CAAS benchmark	ORNL-IE4	Participate in design. Provide materials and instrumentation. Provide analysis of results.	C. Wilson T. Birkett	M. Dunn T. Miller	ORNL LLNL
AWE-IE7	Correction factor for dosimetry linked to orientation of the victim	LLNL-IE1	Participate in design and analysis. Participate in experiment with UK accident dosimetry	C. Wilson L. Buchanan	D. Heinrichs	LLNL
AWE-IE8	Sub-critical leakage spectrum measurements	LANL-IE3	Provide capability to measure neutron and photon leakage spectra from sub-critical assemblies	C. Wilson L. Clark	J. Hutchinson	LANL
Training and Education						
AWE-T&E1	Criticality Training Course at NCERC	LANL-T&E1	Criticality Safety Assessors to attend Hands-On course at NCERC	R. Jones		LANL